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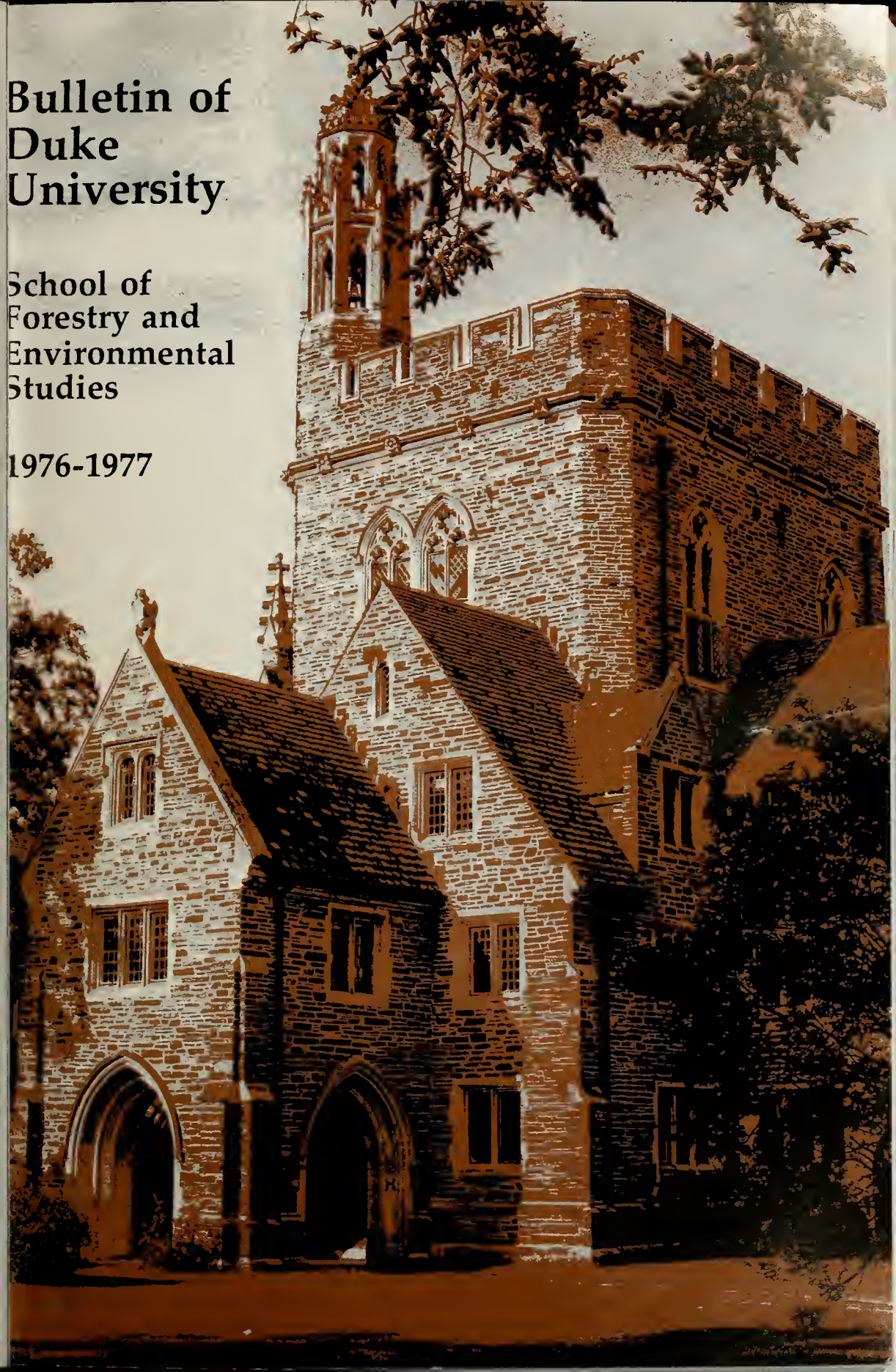




# Bulletin of Duke University

School of  
Forestry and  
Environmental  
Studies

1976-1977





**Bulletin of  
Duke University,** *Durham, 71 8*

**School of Forestry  
and  
Environmental Studies**

**1976-1977**

**Durham, North Carolina 1975**

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson  
Duke University Bulletins Office

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Elizabeth Matheson

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# Contents

School of Forestry and Environmental Studies Calendar	iv
University Administration	iv
School of Forestry and Environmental Studies Faculty and Staff	v
<b>General Information</b>	v
Duke and the School of Forestry and Environmental Studies	1
<b>Program Information</b>	2
Fields of Study	3
Master of Forestry Degree	4
Master of Environmental Management Degree	7
Master of Science Degree	8
Master of Arts Degree	9
Doctor of Philosophy Degree	10
General Requirements of the D.F. and Ph.D. Degrees	10
<b>Cooperative Plan of Study</b>	14
Program with Selected Colleges and Universities	15
<b>Admission</b>	18
<b>Registration and Regulations</b>	22
Registration	23
Academic Regulations	25
<b>Resources for Study</b>	26
General and Research Facilities	27
<b>Student Life</b>	30
Living Accommodations	31
Services Available	33
<b>Financial Information</b>	36
Tuition and Fees	37
Living Accommodations	38
Motor Vehicles	39
Student Aid	39
Loans	40
<b>Courses of Instruction</b>	42
Appendix	54

# School of Forestry and Environmental Studies Calendar

1976

<b>June</b>	
21	Monday—Summer Session classes begin
<b>August</b>	
27	Friday—Summer Session ends
<b>September</b>	
7	Tuesday—Fall semester classes begin
<b>November</b>	
24-26	Wednesday-Friday—Thanksgiving holiday
29	Monday—Classes resume
<b>December</b>	
13	Monday—Fall semester classes end
15	Wednesday—Final examinations begin
22	Wednesday—Final examinations end

1977

<b>January</b>	
17	Monday—Spring semester classes begin
<b>March</b>	
14-18	Monday-Friday—Spring break—spring field trips
<b>April</b>	
29	Friday—Spring semester classes end
<b>May</b>	
3	Tuesday—Final examinations begin
10	Tuesday—Final examinations end
15	Sunday—Baccalaureate and Commencement

## University Administration

### GENERAL ADMINISTRATION

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*

John O. Blackburn, Ph.D., *Chancellor*

Frederic N. Cleaveland, Ph.D., *Provost*

Charles B. Huestis, *Vice President for Business and Finance*

William G. Anlyan, M.D., *Vice President for Health Affairs*

Juanita M. Kreps, Ph.D., *Vice President*

J. David Ross, J.D., *Vice President for Institutional Advancement*

Victor A. Bubas, B.S., *Vice President for Community Relations*

Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*

J. Peyton Fuller, A.B., *Controller*

Harold W. Lewis, Ph.D., *Vice Provost and Dean of Faculty*

John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*

John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*

Ewald W. Busse, M.D., *Associate Provost and Director of Medical and Allied Health Education*

Stuart M. Sessoms, M.D., *Director of Duke Hospital*

Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*

Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*

William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*

Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*

Connie R. Dunlap, M.L.S., *Librarian*  
William E. King, Ph.D., *University Archivist*  
Clark R. Cahow, Ph.D., *University Registrar and Director of Undergraduate Admissions*  
Olan Lee Petty, Ph.D., *Director of the Summer Session*  
Rufus H. Powell, LL.B., *Secretary of the University*  
Charles Linn Haslam, J.D., *University Counsel*

## **SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES ADMINISTRATION**

Charles William Ralston, M.F., Ph.D., *Dean of the School of Forestry*  
Fred Myerle White, M.F., *Director of the Duke Forest and Assistant to the Dean*  
Robert Lloyd Barnes, M.F., Ph.D., *Director of Admissions*  
Roger Fabian Anderson, M.S., Ph.D., *Director of Graduate Studies in the Department of Forestry of the  
Graduate School*

## **School of Forestry and Environmental Studies Faculty and Staff**

Roger Fabian Anderson (1951), M.S., Ph.D., *Professor of Forest Entomology*  
Robert Lloyd Barnes (1965), M.F., Ph.D., *Professor of Forest Biochemistry*  
Leon Edward Chaiken (1952), M.F., *Professor of Forest Management*  
Frank J. Convery (1971), M.S., Ph.D., *Assistant Professor of Natural Resource Economics*  
Jarir S. Dajani (1971), Ph.D., *Assistant Professor of Environmental Studies*  
Henry Hellmers (1965), Ph.D., *Professor of Botany*  
Frederick Charles Joerg (1947), M.B.A., *Professor of Forest Management*  
Kenneth Richard Knoerr (1961), M.F., Ph.D., *Professor of Forest Meteorology*  
Jane Philpott (1951), Ph.D., *Professor of Botany and Professor of Wood Anatomy*  
R. Rajagopal (1974), M.E., Ph.D., *Assistant Professor of Quantitative Science*  
Charles William Ralston (1954), M.F., Ph.D., *Professor of Forest Soils*  
William James Stambaugh (1961), M.S., Ph.D., *Professor of Forest Pathology*  
P. Aarne Vesilind (1970), Ph.D., *Associate Professor of Environmental Studies*  
Fred Myerle White (1959), M.F., *Assistant Professor of Silviculture*  
John Francis Williams III (1973), M.F., *Lecturer (part-time)*  
James Edward Wuenschel (1970), M.S., Ph.D., *Assistant Professor of Forest Ecology*  
David Owen Yandle (1967), M.S., Ph.D., *Associate Professor of Forest Mathematics*

## **ASSOCIATE FACULTY**

Donald J. Fluke, Ph.D., *Professor of Zoology*  
Aubrey W. Naylor, Ph.D., *Professor of Botany*

## **ADJUNCT FACULTY**

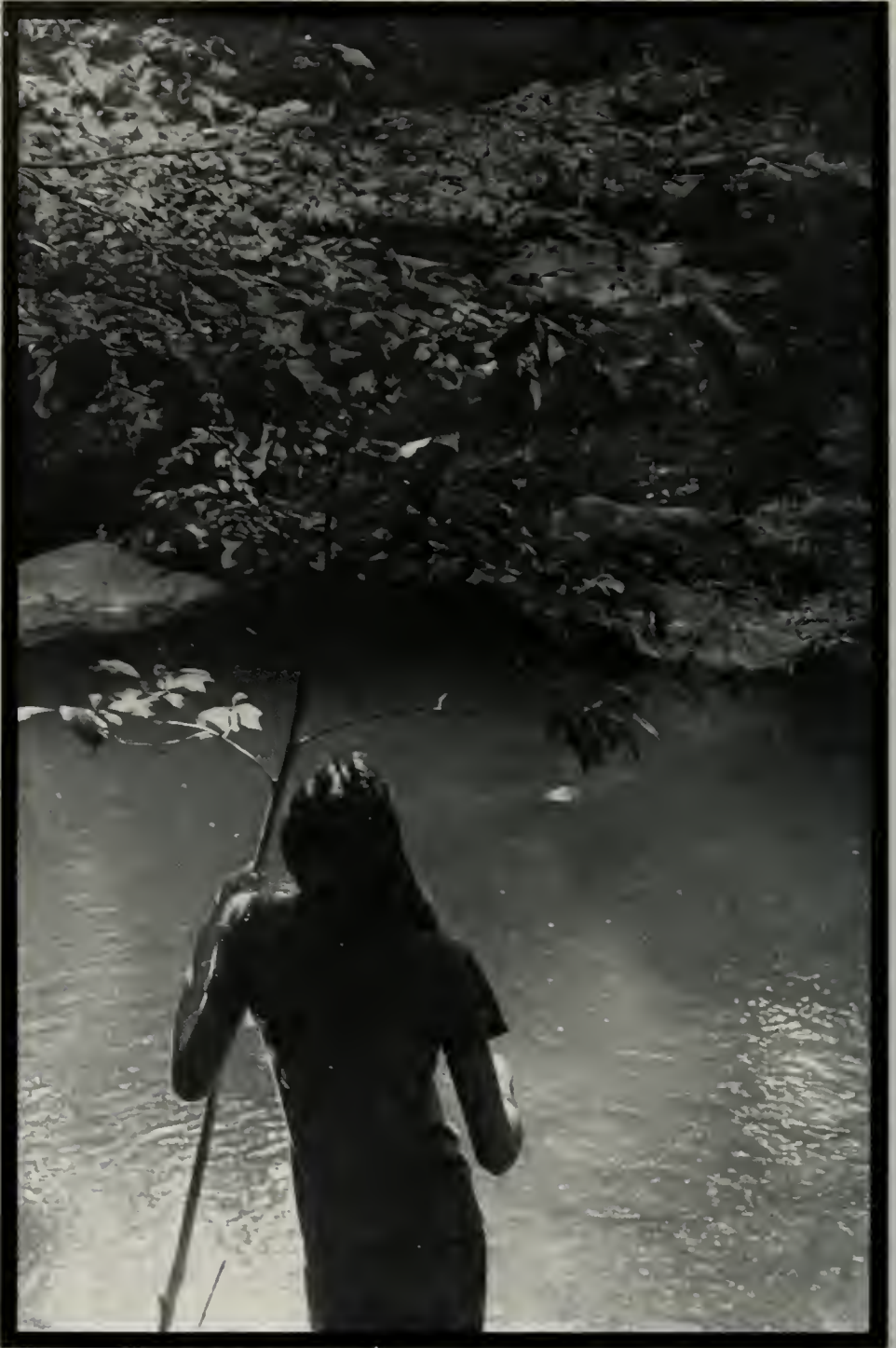
Edgar W. Clark, Ph.D., *Adjunct Associate Professor of Forest Entomology*  
Milton S. Heath, Jr., LL.B., *Adjunct Professor of Environmental Law*  
Charles S. Hodges, Jr., M.F., Ph.D., *Adjunct Associate Professor of Forest Pathology*  
Louis J. Metz, M.F., Ph.D., *Adjunct Associate Professor of Forest Soils*  
Fred M. Vukovich, Ph.D., *Adjunct Associate Professor of Forest Meteorology*

## **STAFF**

Patricia S. Rorie, *Recorder and Secretary to the Dean*  
E. Otto Griffin, Jr., *Superintendent, Duke Forest*  
Sue P. Hicks, *Secretary, Duke Forest*  
Nancy A. McMannen, *Secretary*  
Jo W. Russell, *Secretary*

## **FACULTY EMERITI**

Paul Jackson Kramer, Ph.D., *James B. Duke Professor Emeritus of Botany*  
James Granville Osborne, B.S., *Professor Emeritus of Forest Biometry*  
Albert Edward Wackerman, M.F., *Professor Emeritus of Forest Utilization*  
Frederick Adolphus Wolf, Ph.D., *James B. Duke Professor Emeritus of Botany*



## General Information



## Duke and the School of Forestry and Environmental Studies

Duke University, located at Durham, North Carolina, comprises Trinity College of Arts and Sciences, the School of Engineering, the Graduate School, and the professional schools of Forestry and Environmental Studies, Divinity, Law, Medicine, Business Administration, and Nursing. The University dates from 1838, when Union Institute was founded in Randolph County by the Methodists and Friends. In 1851 the institution became Normal College, one of the first schools in America for the training of teachers. In 1859 the name was changed to Trinity College by which it was known for sixty-five years.

Then on December 11, 1924, James Buchanan Duke executed the Indenture of Trust that provided for hospitalization, church work in rural communities, and education. The principal feature of the educational provision was the creation of Duke University.

Now, the University, with a student body totaling 8,000, occupies two campuses. The East Campus of 108 acres was formerly the campus of Trinity College. About a mile west are the newer units of the University, known as the West Campus, totaling 467 acres. It was first occupied in September, 1930.

Forestry at Duke University began early in 1931 when the Duke Forest was placed under intensive forest management and forestry research was initiated. An academic-forestry curriculum, designed for men and women intent upon pursuing forestry as a profession, was organized in Trinity College of Duke University in 1932. This program was enlarged in 1952 and now includes more than sixty cooperating colleges and universities. (See pages 15-17).

In 1938 the School of Forestry was organized at the graduate level and a curriculum was offered leading to the degree of Master of Forestry. Work leading to the degree of Doctor of Forestry has been offered since 1940. In 1969 the School began responding to demands for individuals with professional expertise in environmental management by developing curricula in this growing field. Graduates of these programs have been awarded the Master of Environmental Management degree since 1975. The School has been fully accredited since its origin. A degree in forestry or environmental studies at the undergraduate level is not offered at Duke University.

Graduates of recognized colleges, universities, professional schools of forestry, and other students who meet the entrance requirements of the School (see page 19) may enroll in forestry programs leading to the professional degrees of Master of Forestry, Master of Environmental Management, and Doctor of Forestry. The Department of Forestry and Environmental Studies in the Graduate School also offers graduate work in certain aspects of forestry leading to the degrees of Master of Arts, Master of Science, and Doctor of Philosophy. This work is available to graduates of schools of forestry of recognized standing and to college or university graduates holding a bachelor's degree. All applicants will be considered without regard to race, color, religion, sex, or national origin.





## Program Information



## Fields of Study

Basic scientific or professional programs of study are available in the following fields of forestry and related natural resources. Interdisciplinary programs between fields within the School of Forestry and Environmental Studies and those in other departments of the University are strongly encouraged.

### Biological Science

Forest Ecology  
Tree Physiology and Biochemistry  
Forest Pathology  
Forest Entomology  
Dendrology and Wood Anatomy

### Statistics and Operations Research

Biometry and Statistics  
Mensuration  
Operations Research

### Environmental Science

Forest Soils  
Forest Meteorology and  
Biometeorology  
Wildland Hydrology

### Economics and Management

Natural Resources Economics and  
Policy

With the exception of forest management, study in all of the above fields can be pursued in programs for a M.S., A.M., or Ph.D. degree in the Department of Forestry and Environmental Studies of the Graduate School, or in a professional program for a M.F., M.E.M., or D.F. degree from the School of Forestry and Environmental Studies. Students contemplating careers in teaching and research are strongly urged to follow courses of study in the Department of Forestry and Environmental Studies in the Graduate School.

In addition, the following special management or business-oriented programs of study leading to the M.F. degree are available in the School of Forestry and Environmental Studies: Post-Liberal Arts and Science Program, Business Management Program, Forest Protection Program, Cooperative Forestry Program, and Natural Resource Ecology and Environmental Management Program for the M.E.M. degree.

Detailed information on these special programs is given under the Master of Forestry Degree, Master of Environmental Management Degree, and the Co-operative Plan of Study section in this *Bulletin*.

## Master of Forestry Degree

The requirements for the degree Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education, both in professional and related subjects, and by his specific career objectives. Usually, students who have earned the degree of Bachelor of Science in Forestry, or the equivalent, from an accredited school of forestry may complete the requirements for the M.F. degree in one academic year. Students with no prior preparation in forestry are required to begin their studies with a summer term of nine weeks. Thereafter, four semesters of study are required under this program for attainment of the M.F. degree. Graduate work of equivalent grade done in residence at other institutions may, with the approval of the faculty, be accepted as credit toward the degree, but a minimum of one year of residence at Duke University is required.

A student who has not completed his thesis while in residence must submit an acceptable manuscript to the faculty within a period of two years following the termination of his residence.

No student may take less than fourteen nor more than eighteen units of credit per semester without special permission of the faculty (see pages 23-25).

**Postliberal Arts and Science Program.** Men and women who are college graduates but have had no prior professional forestry training may be admitted to programs of study leading to the degree of Master of Forestry. Depending on the program of study, sixty to seventy units of credit in residence are minimal requirements, including the summer session and core courses listed below. In the case of students with advanced preparation equivalent to these specific subjects, total unit credit requirements may be reduced. Such reductions will be approved on an individual basis and only on specific recommendation of the student's major program adviser and approval by the faculty.

### Summer Session

	Units
Careers in Natural Resources (For. 200)	0
Tree Growth and Development (For. 205)	3
Dendrology (For. 241)	3
Forest Measurements (For. 256)	4
Interpretation of Aerial Photographs (For. 289)	2

### Core Courses

Soils and Forest Resources (For. 261)	3
Natural Resource Ecology (E.S. 243)	3
Resource Economics and Policy (For. 269)	3

During the latter part of the first year, each student will be requested to designate the field (or fields) he wishes to pursue for a major. After the student has designated his field of interest, he will be assigned a faculty adviser who, in consultation with the student, will develop a program of study in a manner similar to that described under the Postprofessional Program (see below).

Any student who does not earn a grade of *E* or *G* in at least six units of work in the first academic year will not be permitted to enter into the work of the second year.

**Postprofessional Program.** Students with satisfactory undergraduate professional training qualify for advanced study and research in the various dis-





ciplines of forestry under this program. A specific study plan is developed for each student through consultation with a faculty advisory committee. For the student planning a managerial career in the general area of forest production (and where the Master of Forestry is planned as a terminal degree), his program of study usually consists of courses and seminars, with a major portion of the work concentrated in the area of the student's interests. For the student with interest in research, the study plan is oriented within a specific discipline in order to prepare him for a research career or for academic training beyond the master's level.

A number of courses offered in other departments of the University are open to qualified students in the School of Forestry and Environmental Studies. One or more of these may be included in a student's study plan when considered advisable by his advisory committee.

A minimum of thirty units, in which the student must earn a grade of *E* or *G* in at least six units, are required for the degree of Master of Forestry under this program. Usually, fifteen units of credit (including the thesis) must be earned in the School of Forestry and Environmental Studies.

**Business Management Program.** A specialized program is offered in the School of Forestry and Environmental Studies in cooperation with the Department of Economics to prepare forestry graduates for managerial careers in the business aspects of industrial forest land management or forest products. The program requires two years of study and training leading to the degree of Master of Forestry. It is open to selected students who have earned a bachelor's degree (or the equivalent) in general forestry, forest management, forest utilization, or wood science and technology, with the proper prerequisites, and who also have potential leadership qualities indicative of administrative and executive ability.

The general requirements of the program are as follows:

1. At least ten courses (thirty units) in economics and business administration or in closely allied fields.
2. Approximately five courses (fifteen units) in forestry which deal with principles of administration and decision-making.

3. Experience as paid managerial trainee with a cooperating firm for a period including the fall semester of the second year and the preceding summer.

4. A written analysis of some phase of the managerial operation of the organization with which the training period is spent.

A specific program of study, commensurate with each student's academic background and future goals, will be developed by the program advisory committee in consultation with the student. A list of suggested courses that might be included in such a program of study is available upon request.

**Forest Protection Program.** A combined program of specialization in entomology-pathology is available for students desiring career preparation in the applied aspects of forest insect and disease control. This program of study leads to the Master of Forestry degree. Students electing the program must hold either a bachelor's degree in general forestry or have equivalent preparation in the biological sciences.

The general requirements of the program are as follows:

1. A minimum of twenty-eight units in forest entomology and forest pathology. With approval, credits in closely related disciplines may be substituted.

2. At least twelve units of courses and seminars dealing with managerial and statistical aspects of forest protection.

3. One summer of employment experience with a forest protection agency.





4. Organization, conduct, and report of applied research on forest insects and/or disease problems (four units).

Reasonable latitude will be permitted in selecting courses to accommodate specific needs and interests. Each program of study will be developed in consultation with the program directors. A list of recommended courses is available upon request.

Applicants for this program must meet the requirements of the School of Forestry and Environmental Studies and the approval of the program advisory committee.

## Master of Environmental Management Degree

The requirements for the Master of Environmental Management degree are governed by the extent of the student's previous undergraduate education and by his specific career objectives.

A student without prior education in environmental management will be required to complete the equivalent of four semesters of resident study (sixty units) beyond the baccalaureate degree level, including the core courses given below. Students accepted from the cooperative college program must complete five semesters of resident study (seventy units). Graduate work of equivalent grade done in residence at other institutions may, with approval of the faculty, be accepted as credit for the degree, but a minimum of one year of residence at Duke University is required.

No student may take less than fourteen or more than eighteen units of credit without special permission of the faculty (see page 25).



## Core Courses\*

	Units
Natural Resource Ecology (E.S. 243)	3
Biometry (For. 250)	3
Computer Science in Natural Resources (For. 253)	3
Soils and Forest Resources (For. 261)	3
Resource Economics and Policy (For. 269)	3
Ecological Principles in Environmental Management (E.S. 341)	3
Environmental Management Seminar (E.S. 347-8) (1 unit per semester)	4
Natural Resource Law and Policy (Plan. 233—UNC)	3

**Natural Resource Ecology and Environmental Management Program.** A professional program is offered to students with career interests in the expanding fields of environmental management and protection. The basic objective of this program is to develop expertise in planning and administering the management of natural resources and the non-urban environment for maximum human benefits with minimum deterioration of ecosystem stability. Emphasis is placed on the ecosystem as the basic unit of natural resource management.

This program of study leads to the Master of Environmental Management degree and is open to students with a bachelor's degree in biological or environmental science or with training in other fields and a strong motivation toward an ecological approach to natural resource problems.

General requirements of the program are:

1. A minimum of twenty-four units in resource ecology and environmental science.
2. At least nine units in courses dealing with statistical or mathematical analysis of natural resource problems.
3. A minimum of fifteen units in courses in resource use planning, business, and public administration.
4. Formulation, analysis, and report of research on an applied problem related to ecological or environmental aspects of natural resource management.

Although all students are expected to have substantive knowledge of principles of resource ecology, environmental science, and quantitative analysis, reasonable latitude is permitted in electing courses to meet the interests and capabilities of individual students. Each program of study will be developed in consultation with the program directors.

## Program in Tropical Forestry

Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section titled "Organization for Tropical Studies" in the *Graduate School Bulletin* in the chapter "Special and Cooperative Programs."

## Master of Science Degree

**Prerequisites.** The degree of Master of Science (M.S.) is offered through the Department of Forestry and Environmental Studies in the Graduate School. As a prerequisite to this degree a student must have earned a baccalaureate degree

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\*Prerequisites: Introductory Biology and Introductory Economics must be completed before entering program or taken without credit after entering program.

from an accredited college or university. There is no foreign language requirement for this degree.

**Major and Minor Subjects.** The work for the Master of Science degree is designed to provide a basic foundation in a fundamental area of forestry or in a field closely allied with forestry. A minimum of thirty units of credit is required for the degree; twenty-four units must be in formal courses although not more than six units can be earned for the thesis. Specific course requirements call for a minimum of twelve units in a major field of specialization and six units in a minor area of concentration. The major and minor fields are determined without regard to departmental divisions of the University if the interdisciplinary nature of the area of specialization makes such a program of study advisable. The specific program of study is developed by the major professor (thesis supervisor), subject to the approval of the Director of Graduate Studies in forestry and the Dean of the Graduate School.

**The Thesis.** At least one month before presenting the thesis, that is on or before February 1 for a May degree or on or before August 1 for a September degree, the student must file with the Dean of the Graduate School, on the official form, the title of the thesis and the declaration of intention to graduate. The title must have the approval of the thesis supervisor and the director of graduate studies in the major department. If the student has met the degree requirements before the above deadlines, he must file his intention to graduate one month before the thesis is presented. The basic requirements for preparing the dissertation, regulating such things as type of paper, form, and binding, are prescribed in the *Guide for the Preparation of Theses and Dissertations* which is available in the Graduate School Office, 127 Allen Building.

Four typewritten copies of the thesis, bound in snap binders supplied by the Library, must be submitted through the Graduate School Office to the Dean of the Graduate School on or before April 15 for a May degree or on or before August 15 for a September degree, and at least one week before the scheduled date of the student's examination. The copies will then be distributed by the student to the several members of the examining committee. Three copies for the library will be bound by the Ruzicka Bindery for a fee of \$5 a volume. The student may request that an additional number of copies be so bound.

**The Examining Committee and the Examination.** The instructor who directs the student's program appoints an examining committee composed of himself and two other members of the graduate faculty, one of whom must be from a department other than that of the major. If the student has been permitted to take related work within the major department, the third member may represent the minor field within the department. The names of the members of this committee are submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

This committee administers the examination and certifies whether the student has passed or failed by signing the card provided for this purpose by the Graduate School Office. This card is used to indicate completion of all requirements for the degree. After a thesis is approved the committee signs all copies of the thesis, and the candidate then returns the original, the first two carbon copies, and any other copies he wishes bound by Ruzicka to the Dean of the Graduate School who deposits them in the University Library.

## Master of Arts Degree

The degree of Master of Arts (A.M.) is offered through the Department of Forestry and Environmental Studies in the Graduate School. As a prerequisite to



admission for this program, a student must have earned a baccalaureate degree from an accredited college or university. Students interested in working toward this degree should refer to the *Bulletin of the Graduate School* for specific requirements.

## Doctor of Forestry Degree

The degree of Doctor of Forestry (D.F.) is a professional and research degree conferred upon those students who have satisfactorily completed specified requirements of advanced study and research.

Work toward the D.F. degree, consisting of advanced studies in a major and a minor field, is offered with majors in the several branches of forestry. A minor may be elected in forestry or in other areas of specialized study in the University approved by the faculty of the School of Forestry and Environmental Studies. Prospective students should correspond with the Director of Admissions to the School of Forestry and Environmental Studies on all matters pertaining to admission to the School.

## Doctor of Philosophy Degree

The Doctor of Philosophy degree (Ph.D.) is conferred through the Graduate School of Duke University. Programs of study and research for men and women working for this degree are directed by faculty members of the School of Forestry and Environmental Studies who also comprise the graduate faculty of the Department of Forestry and Environmental Studies in the Graduate School. Both major and minor programs of study are available in the following branches of forestry: forest biochemistry, forest biometry, forest meteorology, forest ecology, forest economics, forest entomology, forest hydrology, forest pathology, forest soils, forest-tree physiology, wood anatomy, and wood chemistry.

The Ph.D. degree is essentially a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

## General Requirements for the D.F. and Ph.D. Degrees

The formal requirements, discussed in detail below, for the doctoral degrees are as follows: (1) foreign language; (2) major and related courses; (3) supervisory committee for program of study; (4) residence; (5) preliminary examination; (6) dissertation; and (7) final examination. In order to be considered for candidacy for a doctoral degree, the student must have passed all of his course work in the first year of graduate study and have made a grade of C or better on at least nine units of that work.

**Foreign Language Requirements.** A reading knowledge of at least one foreign language is required for the D.F. and Ph.D. degrees. Languages usually taken are French, German, and Russian. Another language which has a definite relation to the degree program and for which an examination can be provided may be substituted for any of these with the approval of the supervisory committee.

A foreign student whose native language is not English may request that the director of graduate studies ask permission of the Dean of the Graduate School to offer English as the foreign language required in his program.

With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. may be waived in individual cases provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the student concerned.

The foreign language requirement(s) may be satisfied in the following ways:

1. The student may take the Educational Testing Service examination at one of many national centers (including the Duke University Counseling Center). To avoid delays, prospective students are urged to take appropriate ETS Graduate School Foreign Language tests prior to registration. However, it should be noted that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language certificates more than six calendar years old will not be accepted toward fulfilling the language requirement.

2. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.

**Special Reading Courses.** Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week. French is offered during the fall semester and occasionally in the spring, and German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by three units, with no reduction in fees. No auditors are permitted in these courses at any time. Undergraduates may not enroll during the academic year but may register, with permission of the Dean of the Graduate School, in the summer session if total registration permits.

**Major and Related Work.** The student's program of study necessarily demands substantial concentration on courses in his major department. It must, however, include a minimum of six units in related fields approved by his major



department. Use of related fields within the major department requires the approval of the Dean.

**Committee to Supervise the Program of Study.** As early in a student's course of study as is practicable and *not later than two months before the preliminary examination*, the director of graduate studies in the major department will nominate for the approval of the Dean a supervising committee of five, with one member designated as chairman. This committee will include at least three members of the major department and one from the minor department, if a minor is involved. This committee will approve the program of study, as well as administer the preliminary examination and the final doctoral examination. Should all members of the committee be from the major department, at least one member of another department will be added or substituted for the final doctoral examination. The final examination may be administered with a minimum of four members.

When the preliminary examination is arranged, the committee and the director will submit to the Dean the student's program of study bearing a statement that the department's course and language requirements have been, or are being, completed.

**Residence.** The *minimum* registration requirement is sixty units of graduate credit, not more than thirty units of which may be accepted by transfer. Since a full program is thirty units per academic year, the prospective doctoral candidate who enters with an A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if he enters with an A.M., M.S., or M.F. degree, his *minimum* residence is one academic year. If there are undergraduate deficiencies in his program, he may, in addition to the minimum requirements, be required to take preliminary undergraduate courses for which he will not receive graduate credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements, if any, above the minimum the student must meet. See pages 23-25 for further information on registration in residence and *in absentia*.

When the preliminary examination is passed, any courses, language certifications, or other credits for advanced standing which are more than six calendar years old will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

Usually the student should pass the preliminary examination by the end of his second year of graduate study. If he has not passed it by the middle of the third year, he must file with the Dean a statement explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the end of the third year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the Dean for an extension of one year. Should this extension be granted and the dissertation not be submitted and accepted within the year, the student must pass a second preliminary examination to remain a doctoral degree candidate. In such a case, the time limit for submitting the dissertation will be determined by the Dean and the candidate's committee.

**Preliminary Examination.** A student is not accepted as a candidate for the doctoral degree until he has passed the preliminary examination. A transfer student who may have passed a preliminary examination elsewhere must, nevertheless, take the examination at Duke. The examination ordinarily covers both the major and minor fields.



In the summer, a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Failure on the second examination will render the student ineligible to continue his program for the doctoral degree at Duke University.

**The Dissertation.** The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

Not later than February 1 (February 2, if February 1 falls on Sunday) preceding the May commencement at which the degree is expected to be conferred, the student must file with the dean of the appropriate school, on the official form to be obtained from the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation. The basic requirements for preparing the dissertation, regulating such things as type of paper, form, and binding, are prescribed in the *Guide for the Preparation of Theses and Dissertations* which is available in the Graduate School Office, 127 Allen Building.

The dissertation must be completed to the satisfaction of the instructor who directs it. Four typewritten copies bound in snap binders secured through the Graduate School Office must be deposited with the dean of the appropriate school on or before April 1 preceding the May commencement when the degree is to be conferred. The dissertation must be submitted at least seven days before the scheduled date of the student's examination.

Doctoral dissertations usually will be published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may, if they wish, copyright them. An abstract will be published in *Dissertation Abstracts*. Before final typing is completed, the candidate should obtain, in the Graduate School Office, detailed instructions on the procedure, together with a microfilming agreement which is signed and returned when the dissertation is finally deposited in the Graduate School Office.

In brief, all copies of the dissertation, with the original in clean type, will remain in spring binders until after the final examination. Three extra copies of the abstract, carefully written and not more than 600 words long, are submitted when the dissertation is first presented to the Graduate School Office. A nonreturnable fee of \$25 is charged for microfilming. If copyright is desired, an additional fee of \$15 is charged. The original and two copies will be bound by Ruzicka Bindery at a cost of \$5 per volume. The student may request that more than three copies be so bound.

**Final Examination.** The final oral examination shall be based primarily upon the dissertation. Questions may, however, be asked in the candidate's major field. Except in unusual circumstances, approved by the Dean, a final examination will be scheduled only when school is in session.

If a student fails his final examination, he may be allowed to take it for a second time, but not sooner than six months from the date of his first. Permission to take the second examination must be obtained from the instructor who directed the dissertation and from the Dean. Failure to pass the second examination renders the student ineligible to continue work for the doctoral degree at Duke University.



## Cooperative Plan of Study



## Program with Selected Colleges and Universities

Since its inception the Duke School of Forestry and Environmental Studies has had the cooperation of Trinity College (the undergraduate college of arts and sciences of Duke University) in preparing students for professional careers in forestry. Under the plan, a student devotes his first three years to a coordinated and carefully integrated program of study in the basic arts and sciences in Trinity College. The following semesters are spent in the School of Forestry and Environmental Studies, and upon successful completion of seventy units of credit in a professional program of study, a student will have earned a baccalaureate degree from Trinity College and the professional Master of Forestry or Master of Environmental Management degree from the Duke School of Forestry and Environmental Studies. In the case of students with advanced preparation relevant to their specific educational objectives, total unit credit requirements may be reduced. Any such reductions will be approved on an individual basis and only with specific recommendation of the student's major program adviser and approval by the faculty.

Based upon the experience and success of this cooperative program with Trinity College, the School of Forestry and Environmental Studies in 1952 initiated similar programs of collaboration with a selected group of colleges and universities located throughout the United States. These programs offer students the numerous advantages of a broad background in liberal arts and sciences as preparation for later professional training. A student intent upon following such a course of study should make application to one of the colleges listed on pages 16-17. Admission requirements and other information pertinent to matriculation may be obtained from each of these institutions. Not later than the end of the first semester of the third year in the college or university of his choice, the student may make formal application for admission to the Duke University School of Forestry and Environmental Studies. To qualify for admission under these programs, a student must have followed a course of study arranged in consultation with his adviser, must have the official recommendation of his college, and must meet requirements for admission to the Duke School of Forestry and Environmental Studies.



# Institutions in the Cooperative Program

## *Alabama*

Samford University, Birmingham 35209

## *Arkansas*

Little Rock University, Little Rock 72204

## *Colorado*

Colorado College, Colorado Springs 80902

## *Florida*

Florida Southern College, Lakeland 33802

Rollins College, Winter Park 32791

Stetson University, College of Liberal Arts, DeLand 32720

## *Georgia*

Mercer University, Macon 31207

## *Illinois*

Illinois Wesleyan University, College of Liberal Arts, Bloomington 61710

## *Indiana*

Butler University College of Liberal Arts and Sciences, Indianapolis 46208

Franklin College, Franklin 46131

Indiana Central College, Indianapolis 46227

## *Iowa*

Iowa Wesleyan College, Mount Pleasant 52641

## *Kansas*

Baker University, Baldwin 66006

## *Louisiana*

Centenary College of Louisiana, Shreveport 71104

## *Maryland*

Western Maryland College, Westminster 21158

## *Michigan*

Albion College, Albion 49224

## *Mississippi*

Millsaps College, Jackson 39210

## *Missouri*

William Jewell College, Liberty 64068

## *Nebraska*

Doane College, Crete 68333

## *New Jersey*

Drew University, College of Liberal Arts, Madison 07940

## *New York*

Hofstra University, Hempstead, Long Island 11550

## *North Carolina*

Catawba College, Salisbury 28114

Duke University, Trinity College, Durham 27706

Guilford College, Guilford College 27410

High Point College, High Point 27262

Wake Forest University, Winston-Salem 27106

## *Ohio*

Baldwin-Wallace College, Berea 44017

Denison University, Granville 43023

Heidelberg College, Tiffin 44883

Kent State University, College of Liberal Arts, Kent 44240

Marietta College, Marietta 45750

Miami University, College of Arts and Sciences, Oxford 45056

Ohio University, Athens 45701

Otterbein College, Westerville 43081

Wittenberg University, Springfield 45501

Youngstown State University, Youngstown 44503

## *Oregon*

Reed College, Portland 97202

Williamette University, College of Liberal Arts, Salem 97301

## *Pennsylvania*

Albright College, Reading 19604

Allegheny College, Meadville 16335

Elizabethtown College, Elizabethtown 17022

Franklin and Marshall College, Lancaster 17603

Gettysburg College, Gettysburg 17325  
Juniata College, Huntington 16653  
Lebanon Valley College, Annville 17003  
Lycoming College, Williamsport 17704  
Moravian College, Bethlehem 18018  
Muhlenberg College, Allentown 18104  
Thiel College, Greenville 16125

*South Carolina*

Furman University, Greenville 29613  
Newberry College, Newberry 29108

*Tennessee*

Carson-Newman College, Jefferson City 37760  
Chattanooga, University of, College of Liberal Arts, Chattanooga 37403  
East Tennessee State University, Johnson City 37602  
Lincoln Memorial University, Harrogate 37752  
Tennessee Wesleyan College, Athens 37303  
Tusculum College, Greeneville 37743

*Texas*

Baylor University, College of Arts and Sciences, Waco 76706

*Virginia*

Bridgewater College, Bridgewater 22812  
Randolph-Macon College, Ashland 23005  
Richmond College—University of Richmond, Richmond 23173  
William and Mary, College of, Williamsburg 23185

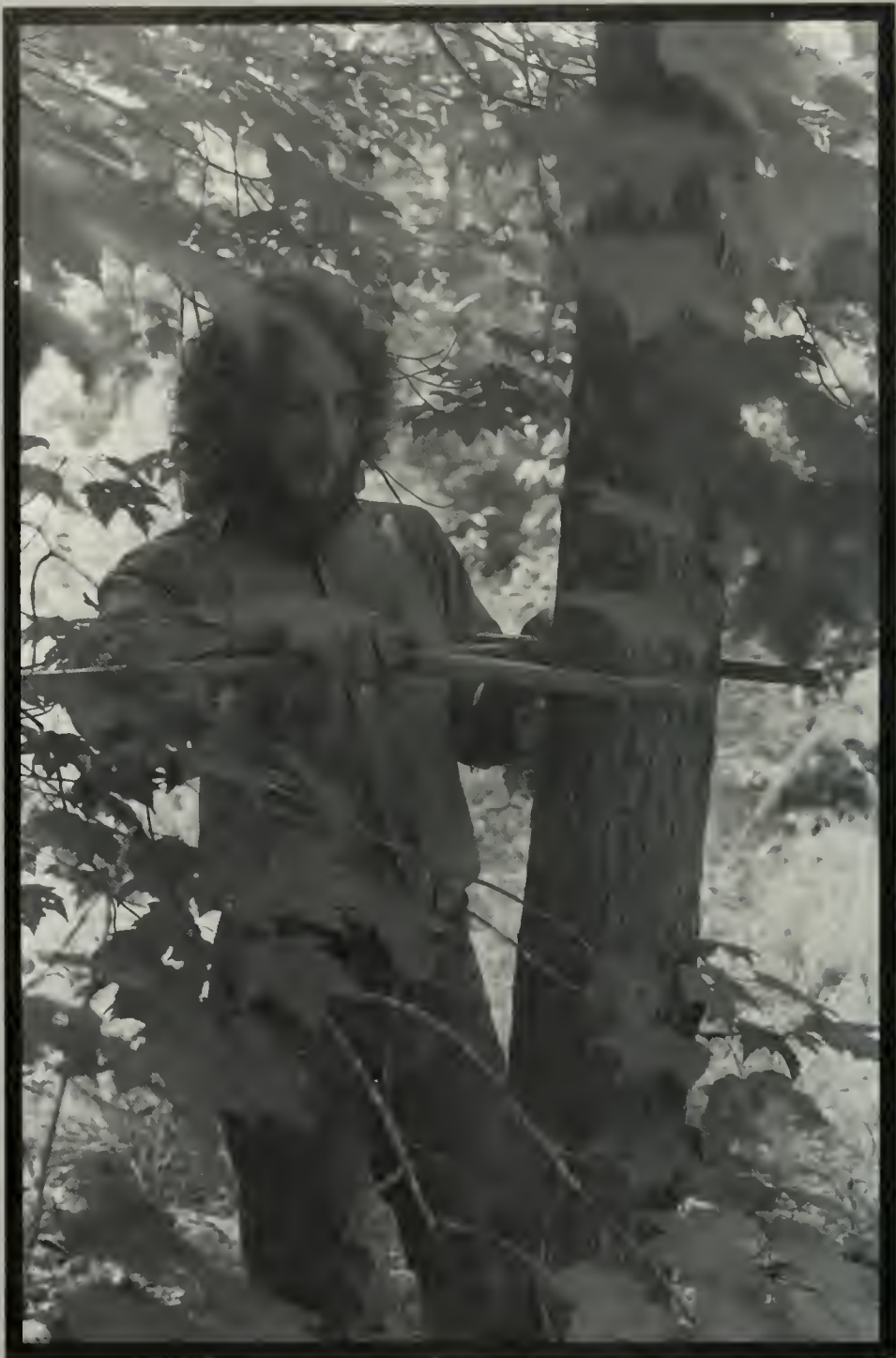
*West Virginia*

Davis and Elkins College, Elkins 26241  
Marshall University, Huntington 25701  
West Virginia Wesleyan College, Buckhannon 26201

*Wisconsin*

Beloit College, Beloit 53512





Admission



## **Master of Forestry or Master of Environmental Management Degrees**

The admission requirements of the School of Forestry and Environmental Studies for work toward the Master of Forestry or Master of Environmental Management degrees presuppose that an applicant is either:

1. a graduate of a professional school of forestry, or
2. a graduate of a college or university of high standing, but without prior professional training in forestry, or
3. a student who has successfully completed three years of approved study at one of the colleges (listed on pages 16-17) in the cooperative program.

Each applicant must present a certified transcript of his academic record showing the courses he has taken, the number of credit hours earned, and the grades received. While few specific courses are required for admission (biology, economics, and mathematics), applicants must be aware that many fields within forestry require academic preparation of a specialized nature. Deficiencies, if any, may be satisfied in residence, possibly prolonging the time necessary to complete degree requirements. Students interested in specialized areas of forestry should write the Dean for advice as to specific preparatory courses.

An applicant who is a graduate of a professional school of forestry will present a certified transcript of his scholastic record. Before registering for the first semester of residence, students will be required to select the branch or branches of forestry in which they wish to concentrate the major part of their work and to prepare their proposed programs in conference with an appropriate faculty advisory committee.

Applicants for all degree programs should plan to take the Graduate Record Examination in the fall preceding application for admission and notice of GRE scores should be sent to the School at time of application.

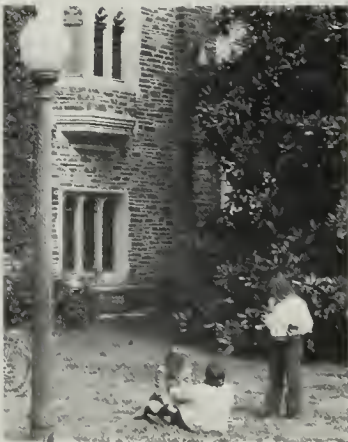
The Admissions Committee of the School of Forestry and Environmental Studies will evaluate and certify applicants to be admitted to all programs of the School.



## Doctor of Forestry Degree

Admission to the School of Forestry and Environmental Studies for a program of study and research leading to the Doctor of Forestry degree is granted to a student who has received the Master of Forestry degree, or its equivalent.

An applicant must file a formal application for admission together with transcripts of his undergraduate and graduate academic records. In his application he should clearly state the branch of forestry in which he desires to concentrate and, if possible, his specific research interests.







## Master of Science and Doctor of Philosophy Degrees

Applications for admission into A.M., M.S., and Ph.D. degree programs in Forestry should be submitted to the Director of Admissions, Duke School of Forestry and Environmental Studies, for transmittal to the Office of the Dean of the Graduate School.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. His undergraduate program should be well rounded and of such quality as to give positive evidence of the capacity for graduate study.

Applicants for all degree programs of the School of Forestry and Environmental Studies will be considered for admission without regard to race, color, religion, sex, or national origin.



## Registration and Regulations



## Registration

All students who enter course work or residence for credit, all students who have completed minimum requirements for an advanced degree but continue to use the facilities of the University in their research, all students with *in absentia* status, and all students who wish merely to audit a course or courses must register.

After the applicant has received notification of his admission to the School of Forestry and Environmental Studies and has returned his statement of acceptance of admission, he may present himself for registration. During the registration periods, announced in this *Bulletin*, he first confers with an assigned faculty adviser who prepares and signs a course card which lists the course work to be taken during the semester. The student then presents this course card to registration officials who enroll him officially in his courses. After his first registration period as a current student he will preregister at the stated times. Former students who intend to register to resume a degree program must give the Director of Admissions notice of this intention two months before registration.

**Late Registration.** All students are expected to register or preregister at the times stated in this *Bulletin*. Those registering late, including those who are obliged to register *in absentia*, are subject to a late registration fee of \$25.

**Change of Registration.** During the academic year, within a period of fourteen days from the registration date, a student may change registration with the approval of his adviser if no reduction of fee is involved, or with the approval of the Dean if a reduction of fee is involved. During the first thirty days from the registration date, the only permissible change is dropping course-seminar registration *and* adding equivalent units of research, with the approval of the student's adviser, the instructor of the course, and the Dean. A period of five weeks from the date of registration is provided for changes resulting from passing a preliminary examination.

**Normal Registration.** A student is designated as fully registered when he registers for the credit his program requires. Required registration is set in consideration of the student's obligation to teach or assist in teaching and the stage he has reached in completion of degree requirements. In the academic year normal registration for the resident student who does not hold an appointment as part-time instructor or assistant or does not engage in part-time work is fifteen units a semester or thirty units an academic year. The normal registration for the student who holds such an appointment or undertakes such work is either twelve





units or a minimum of nine units, depending upon the number of hours a week he is required to devote to such duties.

The resident student in a terminal A.M. or M.S. degree program which requires no thesis carries normal registration until he has met all degree requirements. If a thesis is required and the student has met all requirements except for submitting his thesis, he registers for three units a semester while in residence or, if he elects to go out of residence, for one unit *in absentia* each semester until the thesis is accepted.

The resident student engaged in a master's degree program which is not terminal but preparatory to a doctoral program registers as though he were a doctoral student.

The resident student in a doctoral program carries normal registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of three units a semester until the dissertation is accepted. If, before or after passing the preliminary examination, he elects to go out of residence, he registers for one unit a semester *in absentia* in order to keep his program active.

It is necessary to be a fully registered student according to the regulations listed above (except when registered *in absentia*) in order to establish eligibility for library carrel and laboratory space, for student housing, for University and some outside loans, and for the Student Health Service including voluntary insurance coverage.

The registration of one unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

In the *summer session* six units a term is maximum registration. Students who are residents in the academic year and wish to continue study and the use of University facilities including Student Health during the summer must register for one unit in the first summer session term. This registration provides use of these facilities for all terms.

## Academic Regulations

**Grades.** Grades in the School of Forestry and Environmental Studies are as follows: *E* (exceptional); *G* (good); *S* (satisfactory); *F* (failing); and *I* (incomplete).

An *I* (incomplete) indicates that some portion of the student's work is lacking, for an acceptable reason, at the time grades are reported. The instructor who gives an *I* for a course specifies the date at which the student must make up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is entered upon the student's record unless his appeal to the Dean for the grade *no credit* is approved. A grade of *F* in any course may result in withdrawal from a degree program.

**Reciprocal Agreements with the University of North Carolina and North Carolina Central University.** Under a plan of cooperation between the University of North Carolina and Duke University, students regularly enrolled in the Graduate Schools of the University of North Carolina during the regular academic year, and paying full fees to that institution, may be admitted to a maximum of two courses per semester in the Graduate School of Duke University upon payment of a nominal registration fee of two dollars and of any other special fees regularly required of all students. Under the same arrangements, students in Forestry and Environmental Studies and the Graduate Schools of Duke University may be admitted to course work at the University of North Carolina and North Carolina State University. A similar arrangement exists with North Carolina Central University at Durham.



**Resources for Study**





## General and Research Facilities

The School of Forestry and Environmental Studies is housed in the south wing of the Biological Sciences Building on the West Campus. General and research laboratories are provided for routine and original studies in all of the subject matter fields. These laboratories are equipped with instruments and facilities for quantitative evaluation of biological materials and processes. Greenhouses and the phytotron adjoining the Biological Sciences Building and nearby Duke Forest offer excellent facilities for biological investigations in controlled and natural environments. An IBM system 370 Model 165 Digital Computer is available for processing research data via terminal facilities at the School. Facilities of allied departments of the University are also available for advanced work in chemistry, economics, genetics, mathematics, plant anatomy, plant ecology, plant physiology, and many other fields.

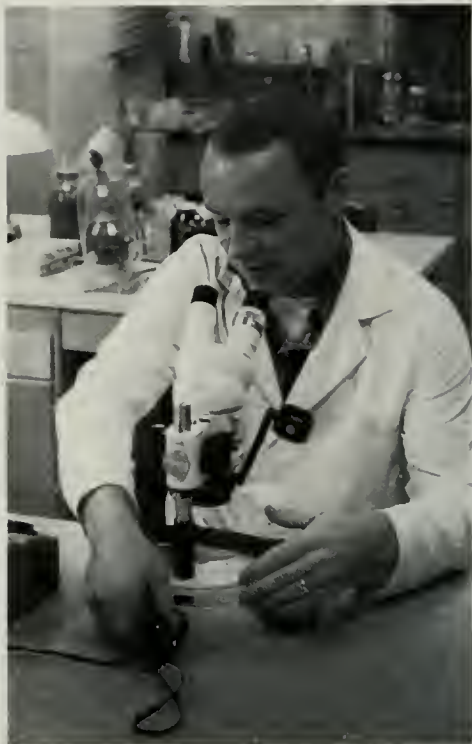
West Virginia Pulp and Paper Company has made available to Duke University a field headquarters for work in the forests of the South Atlantic Coastal Plain. This camp, located eighteen miles northwest of Summerville, South Carolina, is used as a base for field instruction in timber harvesting, wood utilization, soils, silviculture, and forest management.

The School periodically sponsors conferences and symposia on industrial forest management and other technical and scientific subjects. These offer the current viewpoints of many outstanding individuals both in forestry and in allied fields.

The University library, with 2,000,000 volumes and 4,000,000 manuscripts, provides exceptional resources and facilities for study and research by undergraduate and graduate students and by visiting scholars. About 80,000 volumes are added annually, and 164 foreign and domestic newspapers and 9,800 periodicals are received currently. Large collections of microfilms of rare books, newspapers, and periodicals are also available.

The Biology-Forestry Library, Chemistry Library, and Physics-Mathematics Library are housed for convenience in the buildings of these departments. The libraries of the Schools of Divinity, Law, Medicine, and Engineering are also housed in the buildings of these schools, all on the West Campus. The library on East Campus includes another 171,000 volumes.

**The Duke Forest.** The Duke Forest, of approximately 8,000 acres, is particularly well situated for field work. A five-minute walk from the campus will take one well into many parts of the area, and even the most distant portions can be reached by automobile in about twenty minutes.



At few other places in America are there provisions for extensive field study and research in forestry literally at the door of a large university. This natural outdoor laboratory, so conveniently located and representative of the region, is a most valuable supplement to the instructional, laboratory, and library facilities of Duke University.

The forest lies mainly in Durham and Orange Counties near the eastern edge of the Piedmont Plateau. A cross section of much of the woodlands in the upper Coastal Plain and lower Piedmont of the Southeast is represented in the forest with its variety of topography, soil, forest conditions, and patterns of past land use. Elevations range from 280 to 760 feet. The soils are derived from such diverse parent material as metamorphic rock of the Carolina slate formation, granite, Triassic sedimentary rock, and basic intrusives. Nearly one hundred tree species are represented. Some eighteen miles of improved woods roads make all parts of these woodlands accessible. Duke Forest serves as an outdoor laboratory for instruction in forestry and allied fields, and as an experimental forest for research in problems of timber growing and in related sciences. It is also used to demonstrate methods of silviculture and forest management applicable to the region.

**Forestry Sciences Laboratory.** The establishment of the Forestry Sciences Laboratory of the United States Forest Service's Southeastern Forest Experiment Station in the Research Triangle Park near Durham provides an unusual opportunity for complementing the research programs of students in the School of Forestry and Environmental Studies. Specialized research projects in forest entomology, pathology, and soils are currently under way at the laboratory. The research staff of the laboratory is available for consultation, participation in seminars, and service on graduate committees of students in the School of Forestry and Environmental Studies. Arrangements may also be made for students to conduct certain aspects of their research at the laboratory.



**Phytotron.** A controlled environment plant growth facility adjoins the Biological Sciences Building. The Duke phytotron contains fifty separately controlled environmental areas. In the chambers and greenhouses it is possible to dissect any total environment in the world. Using this procedure, one can study the influence of many environmental factors on the growth processes of trees. The chambers accommodate trees up to six feet tall, the greenhouses even larger plants. The Duke phytotron is one of three such laboratories in the United States.

**Duke Environmental Center.** The Duke Environmental Center is an interdisciplinary University-wide organization for the encouragement and coordination of research and training in environmental subjects. The Center provides students access to coursework, research, and expertise in all departments of the University and outside agencies involved in environmentally related activities. It also sponsors environmental courses and seminars and maintains an environmental reading and reference room. Students in the School of Forestry and Environmental Studies may become affiliated with the Environmental Center through working with one of several forestry faculty members who are involved in center activities.

**National Environmental Research Center.** The Durham area has the greatest concentration of Environmental Protection Agency (EPA) offices and activities outside of Washington, D.C. The EPA National Environmental Research Center in the Research Triangle Park is the national center of air pollution research and regulation activities. This facility provides a unique opportunity for cooperative research and advanced training in air pollution and other environmental subjects.





## Student Life





## Living Accommodations

**Housing.** Duke University provides residence hall and apartment accommodations for single graduate and professional men and women. Duke University has a 500-unit housing facility known as Central Campus Apartments. The complex provides housing for married graduate and professional students, single undergraduate and graduate students, and single and married students in nondegree programs related to allied health.

For single students the efficiencies and one, two, and three bedroom apartments are fully furnished. The apartments for married students include a few furnished efficiencies and a number of one, two, and three bedroom units in which the kitchen, living room, and first bedroom are basically furnished and equipped. Eligible married students will find that the apartments provide economy and convenience yet allow them to introduce individual character by using their own furnishings and accessories.

The monthly rental rates for each type of apartment are lower than those offered on the current local housing market. For further information on these apartments, married and single students should write: Manager of Apartments and Property, Duke University, 217 Anderson Street, Durham, North Carolina 27706.

The University also will provide assistance to married graduate and professional students in locating suitable housing in Durham, where varied types of reasonably priced units are available.

The Graduate Center, near the Medical Center, and Town House Apartments house men and women enrolled on a full-time basis in the graduate and professional schools. Town House Apartments are located between East and West Campuses.

The Graduate Center houses 148 male graduate students, 56 female graduate students, and 117 female undergraduate students. Commons facilities on the main floor are shared by men and women.

Students are usually licensed to occupy graduate residential space for the academic year, but for no period less than a semester or specified term.

Duke University operates Town House Apartments primarily for graduate and professional school students. Others are housed in individual apartments if the interests of the University are served. There are thirty-two two-bedroom units, each furnished for three occupants. Two students occupy the master bedroom with adjoining half-bath, and the third occupies a smaller bedroom. A living room, kitchen, and full bath complete the living arrangement. Additional features are air-conditioning and a swimming pool. The campus bus, serving all

parts of the University, is accessible to the Town House Apartments. Students must pay their own utilities for each apartment.

The Department of Housing Management is prepared to assist the married graduate and professional school students in locating suitable housing in Durham. There are many relatively new complexes and a few older apartments. Houses and duplex units are available in limited numbers from time to time.

Detailed information about University housing facilities for single students and the housing assistance program for married students will be provided upon request by the Department of Housing Management, Duke University, Duke Station, Durham, North Carolina 27706.

Rooms and residence halls and spaces in the Town House Apartments or other residential units may be reserved by applicants only if they have been accepted by the graduate or professional schools and after the required \$50 residential deposit has been paid to the University. The initial residential deposit is required with the application and is held until the room or apartment is vacated. Application forms and detailed information on graduate housing will be mailed when the graduate or professional schools have notified the Department of Housing Management of official acceptance of the student. Single students may express a choice for the type of housing desired. Completed applications for rooms and apartments are to be returned with the required deposits to the Department of Housing Management. Assignment priority is established by the date completed applications and deposits are received in this office.

Regulations governing occupancy of rooms and apartments will be provided by the Department of Housing Management at the time application forms are forwarded to accepted students. Occupants within each type of housing are expected to comply with the appropriate regulations.

For the cost of housing, see the section on Financial Information.

**Dining Service.** The dining facilities on the West Campus include two cafeterias with multiple-choice menus, a snack bar, and the Oak Room where full meals and *a la carte* items are served. In the Graduate Center there is a cafeteria with multiple-choice menus and a coffee lounge where sodas and sandwiches are served.

Due to the large number served in the dining halls, it is not possible to arrange special diets for individual students.





## Services Available

**Medical Care.** The aim of the University Health Service is to provide medical care and health advice necessary to help the student enjoy being a part of the University community. To serve this purpose, both the University Health Services Clinic and the University Infirmary are available for student health care needs.

The main components of the Health Service include the University Health Services Clinic, located in the Pickens Building on West Campus, and the University Infirmary on the East Campus. Emergency transportation, if required, can be obtained from the Duke Campus Police. Residential staff personnel should be consulted whenever possible for assistance in obtaining emergency treatment.

The facilities of the University Health Services Clinic are available during both regular and summer sessions to all currently enrolled full-time students. The facilities of the University Infirmary are available during the regular sessions only from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students.

To secure the benefits of the Student Health Program, a graduate student during the terms or semester in which the illness occurs, must (1) in the summer session term be registered for at least one unit of research or three units of course work, (2) be registered for at least nine units per semester if minimum residence requirements have not been met.

Students are not covered during vacations, and their dependents and members of their family are not covered at any time.

The resources of the Duke University Medical Center are available to all Duke students and their spouses and children. Charges for any and all services received from the Medical Center are the responsibility of the student as are the charges for services received from physicians and hospitals not associated with Duke University.





The Student Mental Health Service, under the direction of Dr. W. J. Kenneth Rockwell, is located in the Pickens Rehabilitation Building and provides evaluations and brief counseling and/or treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse or spouse and child. Although participation in this program is voluntary, the University expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, while traveling between home and school, and during interim vacation periods. Term of the policy is from opening day in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

**The Duke University Counseling Center.** Through the counseling center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the



center. A continuing program of research in the areas of counseling and testing is also carried on by the staff of the center.

**Office of Placement Services.** Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with students about their future professional plans. Students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations are far easier to accumulate during the time a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year through the Placement Office for those students who have registered. Copies of academic records are released only with the permission of the individual.

## **Student Activities**

Students new to Duke University are reminded that they are welcome to use such recreational facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, instrumental, drama, and religious groups.

Students are encouraged to maintain broad professional contacts by participation in the activities of the Society of American Foresters, the Forest Products Research Society, the national honorary scientific society of Sigma Xi, and other societies appropriate to their major field of study.

The social and business events of the Forestry club provide opportunities for many pleasant extracurricular activities. An active organization of the wives of forestry students, the Forestry Dames, offers a regular schedule for social occasions of interest to this group.

## **Conduct of Students**

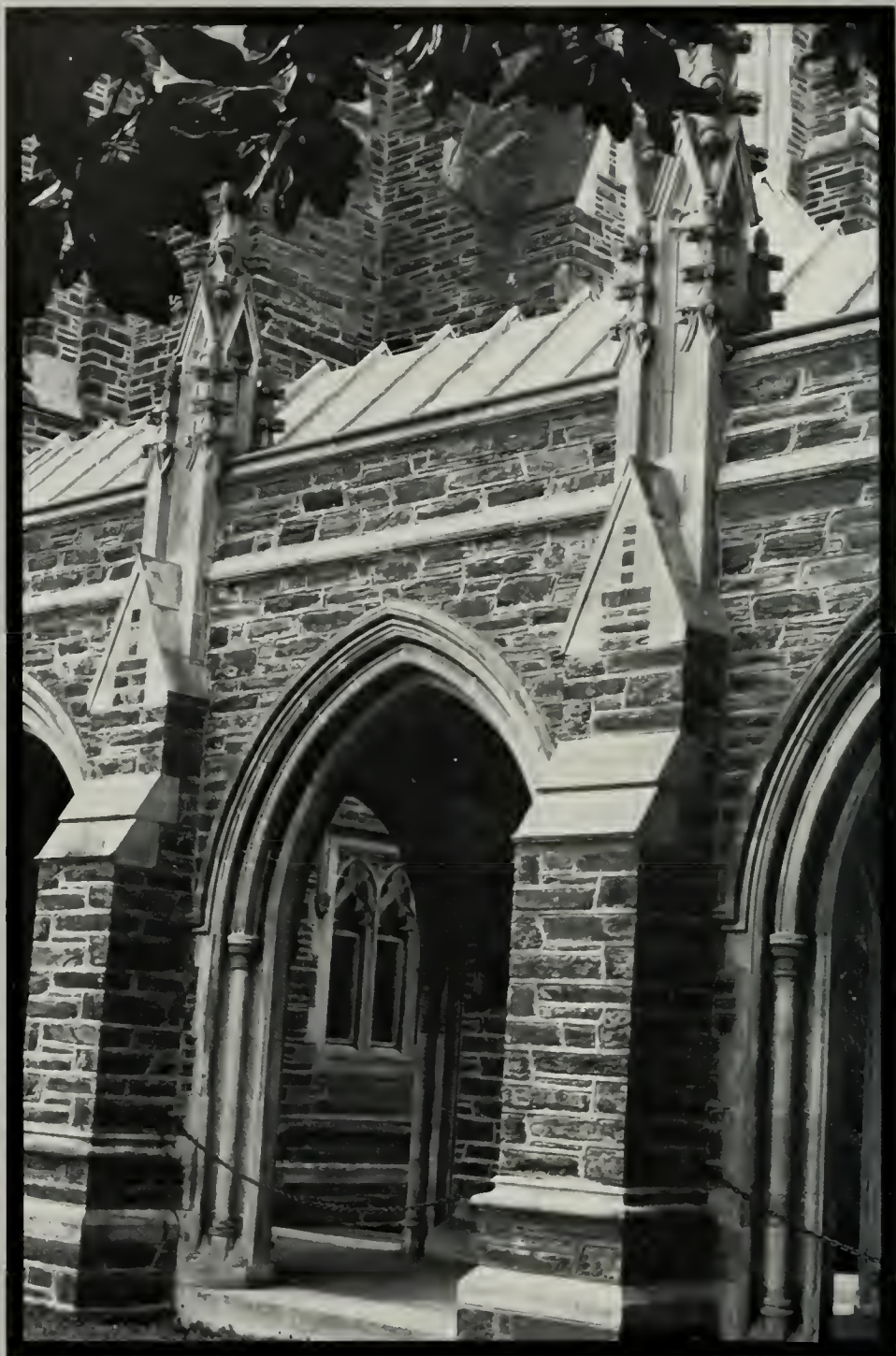
Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University as are currently in effect or as are put into effect from time to time by the appropriate authorities of the University.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations, or for conduct adjudged unsatisfactory or detrimental to the University.

## **Visiting Scholars**

The libraries and, to the extent practicable, other facilities of Duke University will be made available to faculty members of colleges and universities who wish to spend a period of time on the campus in pursuit of their scholarly interests. No fees will be charged such visitors unless they wish to participate in activities for which a special fee is assessed. Room and board may be arranged for at the regular rate in the dormitories and dining rooms. Dormitory space is usually available during the summer months. Inquiries concerning residence for visiting scholars should be directed to the Dean of the Graduate School.



## Financial Information



## Tuition and Fees\*

The following table shows the charges collected from all students for the year 1975-1976. All charges for each semester are due and payable at the time specified by the University, and no student is admitted to classes until arrangements have been made with the Bursar of the University for the settlement of such charges. After the beginning of classes, no refund of tuition will be made except for involuntary withdrawal to enter the armed services or in accordance with established University policy.

Tuition, per semester .....	\$ 1,525
Tuition, summer session, per unit .....	86.00
non-laboratory course .....	258.00
laboratory course .....	344.00
Spring field seminars .....	15.00 to 25.00
<i>In Absentia</i> Fee, per semester (when applicable) .....	102.00

Forestry students may obtain admission to all regularly scheduled University athletic contests held on the University grounds during the entire academic year by payment of an athletic fee of \$25 per year, plus any federal taxes that may be imposed. This fee is payable in the fall semester.

**Tuition Refund Policy.** Tuition refunds are governed by the following policy:

1. In the event of death or a call to active duty into the armed services, a full tuition refund is granted.
2. In all other cases of withdrawal, students or their parents may elect to have tuition charges refunded or carried forward as a credit for later study, according to the following schedule:
  - a. Withdrawal before the beginning of classes: full refund.
  - b. Withdrawal during the first or second week of classes: 80 percent.
  - c. Withdrawal during the third through fifth week: 60 percent.
  - d. Withdrawal during the sixth week: 20 percent.
  - e. No refunds after the sixth week.
  - f. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

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\*Although these fees are based upon existing charges, they are subject to change.



**Late Registration.** Students who register in either semester at a date later than that prescribed by the University must pay the Bursar a fee of \$25.

**Audit Fee.** If a student registers and pays fees for twelve units or more, he may audit one course without charge. Should he be permitted to audit a second course or should he be registered for less than twelve units the audit fee is \$40 per course.

**Transcripts.** A student may request transcripts of his academic record. A minimum fee of \$2.00, payable in advance, is charged for a single copy. A charge of fifty cents will be made for each additional copy of the same order.

## Debts

No records are released and no student is considered by the faculty as a candidate for a degree until he has settled with the Bursar for all indebtedness.

## Living Accommodations

**Housing Fee.** The charge for each person in a double room for the academic year is \$460 in the Graduate Center. A limited number of single rooms are reserved for returning students.

The fee for Town House Apartments is \$692 per student for the academic year on the basis of three students to an apartment. Utility charges are not included in these fees.

Housing fees are subject to change prior to the 1976-1977 academic year. A \$50 deposit is required on all reservations.

**Refunds.** The \$50 reservation deposit will be refunded to students (1) whom the University does not permit to return, (2) who graduate, or (3) who request the refund prior to registration, thus indicating their intention not to return for the following semester. The reservation deposit will not be refunded to students who register but fail to enter the following semester on schedule.

The section on Living Accommodations in the chapter "Student Life" describes arrangements for refund of the \$50 room deposit and gives further information on housing facilities.





**Dining Service Fee.** The cost of the dining facilities discussed on page 32 will approximate \$830, depending on the tastes of the individual.

## Motor Vehicles

Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$20 for each automobile or \$10 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and a \$20,000 per accident for personal injuries, and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

## Estimated Expenses for the Academic Year

The following table represents an estimate of a graduate student's basic expenses in the School of Forestry and Environmental Studies for the year 1975-1976. It should be noted, however, that this estimate does not include any allowance for travel, clothing, and other miscellaneous expenses, as these costs will vary depending on the needs, habits, and tastes of the individual.

	<i>Low</i>	<i>Moderate</i>	<i>Liberal</i>
Tuition .....	\$3050.00	\$3050.00	\$3050.00
Room-rent* .....	460.00	585.00	655.00
Board .....	775.00	830.00	885.00
Laundry .....	40.00	50.00	60.00
Books .....	60.00	75.00	110.00
Athletic Fee (Optional) .....	25.00	25.00	25.00
Spring Field Semesters .....	15-25	15-25	15-25

\*In the Graduate Center.

## Student Aid

A number of fellowships, scholarships, and assistantships are allocated to the School of Forestry and Environmental Studies for the encouragement and financial assistance of men and women who offer promise of becoming leaders in their fields. These are awarded to applicants of high character on the basis of scholastic ability as judged by previous educational performance, professional experience, personal references, and the Graduate Record Examination. Holders of the awards will pay tuition and such additional fees as are regularly required.

**Fellowships.** Stipends range from \$2,300 to \$4,000 per academic year. Each recipient must have previously completed work equivalent to that required at Duke University for a master's degree with a major in forestry, environmental studies, or in a related basic discipline. Students receiving fellowships will devote their time to an approved program of study and research in any of the branches of forestry, and they are expected to become candidates for the Doctor of Forestry or Doctor of Philosophy degree.

**Remission of Tuition.** Children of ministers in the North Carolina and the Western North Carolina Annual Conferences of the United Methodist Church may be eligible to receive a remission of the tuition charge for a maximum of eight semesters of undergraduate study at Duke University. Eligibility is met by the parent being in a regular pastoral appointment; when the parent is in a special appointment, eligibility will be determined on an individual basis depending upon the nature of the appointment. In all cases the decision of the University will be final.

**Scholarships.** Stipends range from \$600 to \$3,200 per academic year. Recipients will usually devote their time to an approved program of study leading to the degree of Master of Forestry, Master of Environmental Management, or Master of Science with a major in forestry.

**Graduate Assistantships.** Graduate assistantships have stipends ranging up to \$4,000, depending upon available funds and upon whether granted for the academic year only, or the academic year plus summer. Recipients will devote half time to research or other work of the School of Forestry and Environmental Studies. They will be permitted to enroll for not more than twenty-four units in an academic year in an approved program of study, or program of study and research.

**Application for Awards.** Any student admitted to the School of Forestry and Environmental Studies is eligible to apply for a fellowship, a scholarship, or an assistantship. Application for these awards may be made concurrently with the application for admission.

The general procedures and requirements for applying for any financial award in the School of Forestry and Environmental Studies are outlined below. Applicants should initiate the necessary action early to ensure that the required documents are filed with the Dean of the School of Forestry and Environmental Studies on or before February 1 prior to enrollment.

1. File award application. Form will be supplied by the School of Forestry and Environmental Studies upon request.

2. Furnish supporting documents as follows: (a) official transcripts of record of all previous college or university credits earned and (b) letters of reference from at least three persons familiar with the applicant's character, scholarship, and professional ability. (Documents offered in support of admission, if so designated, may also serve in support of the application for financial award.)

3. Complete the Aptitude Test of the Graduate Record Examination. Instructions and application for admission to this locally administered examination are available on most college campuses, from the Duke School of Forestry and Environmental Studies, or by writing the Educational Testing Service, Princeton, New Jersey. Applicants should plan to take this examination in December or earlier.

Notification of awards is made on March 15. In case vacancies occur, completed applications received after February 1 will be considered at a later date.

In every instance where a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or prospective graduate student and accepted before April 1, the recipient may resign his appointment without prejudice prior to that date by notification in writing to the Dean. However, an acceptance given or left in force after April 1 obligates him not to accept another appointment without first obtaining formal release from the Dean of the School.

## Loans

Students who are enrolled as full-time degree candidates and who have satisfactory academic and citizenship records are eligible to apply for student loans.

**Champion Paper Foundation Fund.** This fund was established in 1971 by a grant of the Champion Paper Foundation in support of the School of Forestry and Environmental Studies. Students may apply for assistance from this fund through the Forestry Financial Aid Office.

**University Student Loans.** The Duke University Federally Insured Loan Program is one of four loan programs specifically designed to help Duke students to meet legitimate educational expenses.

The other loan programs are the National Defense Student Loan program and the restricted University loan programs supported by privately donated funds. We recommend a review of each program to determine the one best suited to the individual student's needs and resources.

Through Duke University and the federal government, students qualify for loans under the Federally Insured Student Loan Program. The federal government assumes risks for loans thus eliminating the collateral requirement. The University, however, must provide the loan funds for the program. The loan is cancelled in the case of the death or total and permanent disability of the borrower.

The Duke University Federally Insured Loan Program allows the student to borrow up to \$2,500 per year at 7 percent interest. Repayment begins nine months after a student completes his education, and he will have up to ten years following graduation or withdrawal from the University to repay the loan.

An interest subsidy is available from federal funds for all students who have demonstrated need through the Graduate and Professional School Financial Aid Service (GAPSFAS). In order to qualify for the interest subsidy from the government a GAPSFAS form must be submitted. Under the subsidy the federal government will make the interest payments accruing during periods of full-time study, military service, or service in Peace Corps or VISTA.

**Other Funds.** In addition to local loan funds, Duke University participates in the student loan program established under the provisions of the National Defense Education Act of 1958. Repayment of these loan funds usually begins ten months after the student terminates full-time study. Interest accrues at the rate of 3 percent per annum commencing nine months after termination of full-time study. Upon completion of the period of grace of nine consecutive months, the monthly repayment period begins, and simple interest on the loan at the rate of three percent starts to accrue.

Special benefits to those teaching in certain public schools permit a portion of the loan to be cancelled, depending upon the length of teaching service.

Applications and complete details regarding the student loan program may be obtained by writing to the School of Forestry and Environmental Studies. In approving loan applications, the Student Loan Committee selects those students who, from the standpoint of financial need, are deserving of this consideration. All applications for loans should be made before July 1 preceding the academic year in which the student plans to matriculate.





**Courses of Instruction**





## General

**For. 152. Conserving Natural Resources.** Fundamentals of natural resource development, use, management, and protection based on principles of the natural and social sciences. 3 units. *Staff*

**For. 200. Careers in Natural Resources.** A weekly seminar which surveys the research and managerial career opportunities in all fields of renewable natural resources. Required of students in Academic-Forestry program. No credit. *Staff*

## Forest Biology

### DENDROLOGY AND WOOD ANATOMY

**For. 206. Anatomy of Woody Plants.** Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations and for study of micro- and ultra-structures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. 4 units. *Philpott*

**For. 241. Dendrology.** Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. 3 units. *White (Summer Session)*

**For. 292. Microtechnique of Woody Tissue.** Preparation of wood for microscopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 206 or equivalents and approval of instructor. (Offered alternate years on sufficient demand.) 3 units. *Philpott*

Related courses in other departments include—*Botany*: Anatomy, Systematics, Physiology; *Chemistry*: Organic Chemistry; *Civil Engineering*: Mechanical Behavior of Materials.

### ECOLOGY

**E.S. 243. Natural Resource Ecology.** An introduction to modern ecology with emphasis on natural resource management. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: consent of instructor. 3 units. *Wuenschel*

**E.S. 337. Ecological Analysis for Environmental Management.** Methods of analyzing ecosystems for environmental impact assessment, land use planning, and other environmental management applications. Lectures, laboratory, and field work in use of maps, aerial photographs, and field surveys for interpretation of physiographic and biological characteristics of terrestrial ecosystems. Prerequisites: Environmental Studies 243 and 341 and consent of instructor. 3 units. *Wuenschel*

**E.S. 340. Ecology and Land Use Planning.** Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Environmental Studies 341 and consent of instructor. 3 units. *Wuenschel*

**E.S. 341. Ecological Principles in Environmental Management.** Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Environmental Studies 243 or other substantive coursework in ecology. 3 units. *Wuenschel*

**E.S. 346. Seminar in Environmental Policy.** Discussion of the political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and Environmental Studies 341 or their equivalents, and consent of instructor. 1 unit. *Convery and Wuenschel*

**E.S. 347, 348. Natural Resource Ecology—Environmental Management Seminar.** Discussion of current ecological and environmental problems and research topics related to the management of natural resources. Credits to be arranged. *Knoerr and Wuenschel*

**E.S. 354. Biological and Resource System Simulation.** Introduction to systems terminology. Differential and difference equations. Probabilistic concepts. Time and event simulations using problem oriented languages such as CSMP, SYNAMO, and GPSS. Applications in biological and resource sciences. Prerequisite: Forestry 250 and 253, or consent of the instructor. 3 units. *Rajagopal*

Related courses in other departments include—*Botany*: Ecology, Plant-Water Relations, Community Analysis and Classification, Principles of Plant Distribution, The Environment, Vegetation of North America, Evolution; *Zoology*: Animal Behavior, Vertebrate Zoology.

## PHYSIOLOGY AND BIOCHEMISTRY

**For. 205. Tree Growth and Development.** Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes (Summer Session)*

**For. 207. Chemistry of Wood Tissues.** Composition of wood at the elemental, molecular, and macromolecular levels, both in woody plants and in processed woods. Distribution and properties of main components and methods of analysis. Prerequisite: organic chemistry or consent of instructor. 3 units. *Barnes*

**For. 208. Physiology of Wood Formation.** Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. *Barnes*

**For. 305. Forest Biochemistry.** Biochemistry applied to structure and func-

tion of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

Related courses in other departments include—*Botany*: Anatomy, Plant Metabolism, Plant-Water Relations, Physiology of Growth and Development; *Biochemistry*: Introductory Biochemistry, Chemistry of Natural Products; *Chemistry*: Organic Chemistry, Chemical Instrumentation.

## **PATHOLOGY**

**For. 222. Biology of Forest Insects and Diseases.** Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work, with emphasis on identification and interpretation of forest and wood degradation. 4 units. *Anderson and Stambaugh*

**For. 223. Forest Pathology.** Survey of major diseases of North American forests and their timbers, with emphasis on current literature. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 4 units. *Stambaugh*

**For. 321. Phytopathological Technique in Forestry.** Fundamentals of phytopathology as applied to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*.

**For. 322. Microbiology of Forest Soils.** Qualitative and quantitative characterization of the microbial populations of forest soils, with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: consent of instructor; mycology or bacteriology is recommended. 4 units. *Stambaugh*

**For. 385. Seminar in Forest Protection.** Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. *Anderson and Stambaugh*

Related courses in other departments include—*Botany*: Mycology, Plant-Water Relations, Physiology of Growth and Development, Cytology, Genetics; *Chemistry*: Organic Chemistry; *Zoology*: Biological Nucleonics; *Biochemistry*: Introductory Biochemistry.

## **ENTOMOLOGY**

**For. 222. Biology of Forest Insects and Diseases.** (See description under Pathology above.)

**For. 225. Chemical Aspects of Forest Protection.** Chemical aspects of organisms attacking trees and of the materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222. 3 units. *Barnes*

**For. 230. Forest Entomology.** Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent, or consent of instructor. 4 units. *Anderson*.

**For. 233. General Entomology.** Principles of morphology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoology, or consent of the instructor. (Offered alternate years on sufficient demand.) 4 units. *Anderson*

**For. 331. Toxicology of Insecticides.** Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology



gy, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. (Offered alternate years on sufficient demand.) 3 units. *Anderson*

**For. 332. Ecology of Forest Insects.** The influence of environmental factors on the vital processes of insects, with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology, or consent of the instructor. 3 units; 4 units with laboratory. *Anderson*

**For. 335. Entomological Research Techniques.** Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. *Anderson*

**For. 385. Seminar in Forest Protection.** (See description under Pathology above.)

Related courses in other departments include—*Zoology*: Ecology, Systematic Zoology, Radiation Biology, Biological Nucleonics, Cellular Physiology, Invertebrate Embryology, Genetics; *Chemistry*: Organic Chemistry; *Biochemistry*: Introductory Biochemistry; *Botany*: Bacteriology; *Microbiology and Immunology*: Microbiology.

## Environmental Science

**E.S. 347, 348. Natural Resource Ecology—Environmental Management Seminar.** (See description under Ecology above.)

## SOILS

**For. 261. Soils and Forest Resources.** Origin, development, and classification of soils, with special emphasis on those developed in humid climates; morphological, physical and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2 and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. *Ralston*

**For. 362. Forest Soil Physics.** Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. (Offered on sufficient demand.) 3 units. *Ralston*

**For. 364. Soil Classification and Mapping.** Classification of soils as natural bodies. Mapping of soils, land-use classes and forest-site classes; field study will be made of soil in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. *Ralston*

**For. 366. Forest Soil Fertility.** The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 261; analytical chemistry is recommended. (Offered on sufficient demand.) 3 units. *Ralston*

Related courses in other departments include—*Botany*: Plant-Water Relations, Physiology of Growth and Development; *Biochemistry*: Introductory Biochemistry; *Chemistry*: Chemical Instrumentation, Elements of Theoretical Chemistry; *Geology*: Sedimentary Minerals.

## METEOROLOGY

**For. 203. General Meteorology.** A general introduction to the science of meteorology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric

thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. 3 units. *Vukovich*

**For. 204. Microclimatology.** Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. 3 units. *Knoerr*

**For. 215. Air Pollution Meteorology.** The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: Forestry 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University.) 3 units. *Staff*

**For. 217. Environmental Instrumentation.** Consideration of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems, including transducers, signal conditioners, and analog and digital recorders. Methods for obtaining and processing computer compatible records. Precision measurement and calibration techniques with primary and secondary laboratory standards. Two lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

**For. 304. Atmospheric Turbulence and Diffusion.** Bulk and molecular aspects of atmospheric turbulence; Navier-Stokes equations and the Reynold's stresses; mixing-length and statistical turbulence theories; similarity hypotheses; turbulent transfer and diffusion in adiabatic and diabatic atmospheres; characteristics of turbulence in various scales of motion from the planetary to sub-inertial range. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

**For. 306. Dynamics of Local Atmospheric Motion.** Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale-forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves, and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations, or consent of instructor. 3 units. (Offered on sufficient demand.) *Vukovich*

**For. 344. Micrometeorology and Biometeorology Seminar.** Advanced topics in the physics of the earth's surface environment with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon-dioxide in relation to exchange processes within the biosphere. Prerequisite: Forestry 204 or equivalent and consent of instructor. 2 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Mechanical Engineering*: Fluid Mechanics, Thermodynamics, Heat Transfer, Transport Phenomena, Boundary Layer Theory; *Mathematics*: Applied Mechanical Analysis, Numerical Analysis; *Chemistry*: Physical Chemistry, Chemical Instrumentation; *Botany*: Ecology, Plant-Water Relations.

## HYDROLOGY

**For. 216. Watershed Hydrology.** Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality, and water yield on wild lands. 3 units. *Hellmers*

**For. 342. Hydrologic Processes.** Physical processes of the hydrologic cycle, with emphasis on those processes which can be modified or controlled by watershed management. 3 units. (Offered on sufficient demand.) *Knoerr*

Related courses in other departments include—*Civil Engineering*: Hydrology, Incompressible Fluid Flow, Mechanics of Fluids; *Mechanical Engineering*: Transport; *Chemistry*: Physical Chemistry, Chemical Instrumentation; *Botany*: Ecology, Plant-Water Relations.

## Resource Economics and Management

### ECONOMICS AND POLICY

**For. 269. Resource Economics and Policy.** Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. 3 units. *Convery*

**For. 270. Economics of Forestry.** Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services; problems of the economics of the firm and industry basic and peculiar to forestry with special attention to the time dimensions of value; the role of forestry in the general economy, including attention to relevant institutional factors. Prerequisite: Forestry 269 or equivalent. 3 units. *Convery*

**For. 271. Financial Management.** Analysis of the problems of management of the financial affairs of the firm: working capital, long-term capital needs, including the development of an optimal capital structure, with attention to tax problems. 3 units. *Joerg*

**For. 272. Business Policy.** An integrating course where, through analysis of case problems from the top management viewpoint, the student is given practice in arriving at effective courses of action for the solution of business problems. 3 units. *Joerg*

**E.S. 273. Economics and Environmental Quality.** Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. 3 units. *Convery*

**For. 277. Seminar in Natural Resource Allocation and Efficiency.** Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced-level course in nonmarket decision-making or Forestry 378 or its equivalent. 1 unit. *Convery*

**For. 378. Seminar in Forest Economics.** Examination and discussion of the application of economic concepts in forestry; the potential contribution of economic analysis to private and public forest management; current research in forest



economics. Prerequisites: Forestry 270 or consent of the instructor; advanced courses in economics and economic theory are desirable. 2 units. *Convery*

Related courses in other departments include—*Economics*: Economic Theory, History, and Systems; Economic Development, Planning, and Fluctuations; Economic Statistics; Monetary and Fiscal Theory and Institutions; International Economics; Manpower, Labor, and Population; Industrial Organization and Public Policy; *Business Administration*: Business Finance, Marketing, and Accounting.

## MANAGEMENT

**For. 210. Forest Utilization.** Introduction to utilization in the managed forest and the principal wood-using industries. A one-week field seminar is an integral part of the course. The field seminar (without the course) can be taken by non-forestry majors. 1 unit, field seminar only; 2 units with course. *Yandle*

**For. 244. Theory and Practice of Silviculture.** Principles governing establishment, treatment, and control of forest stands; natural and artificial methods of reproduction, intermediate cuttings, and cultural operations, with emphasis on the principal forest types of temperate North America. Field practice in silvicultural operations and study of managed stands. Prerequisite: Forestry 243 or equivalent. 2 units; 3 units with laboratory. *White*

**For. 245. Management of Small Woodlands.** Practical application of principles of forest management to small tracts. Field examinations, compilation of data, negotiations and actions for landowners in diverse market and tax situations. 3 units. *Williams*

**For. 247. Forest Recreation and Landscape Management.** Focuses on developing a methodology for the integration of forest recreation and management practices that enhance and preserve the visual characteristics of the landscape. Emphasis will be placed on (1) the recognition and appreciation of natural landforms and cultural landscapes, (2) the evaluation of important ecological and natural processes that further define the landscape and place limits on its use, (3) the interaction of factors influencing the potential recreational use of forest lands, and (4) an examination of potential criteria for use of forest lands, and (4) an examination of potential criteria for the evaluation of alternative management strategies. Prerequisite: consent of instructor. 3 units. *Chaiken and Wuenschel*

**For. 248. Forest Regeneration.** The fundamentals and application of forest tree improvement, nursery operations, and site-improvement techniques to the regeneration of forest stands by artificial and natural means. 3 units. *Chaiken and White*

**For. 256. Forest Measurements.** Application of plane-surveying technique to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. *White (Summer Session)*

**For. 281. Forest Management.** Principles of organizing forest properties for systematic management; use of data obtained in surveys and inventories; principles of forest regulation, including a study of normal and actual forests, rotations, cutting cycles, and methods of regulating the cut in even-aged and all-aged forests for sustained yield; introduction to the preparation of preliminary forest management plans. 3 units. *Chaiken*

**For. 283. Fire Behavior and Use.** Impact of destructive agencies upon forests; principles of combustion, fire behavior, danger measurement, and suppression; use of fire in forest management. 2 units. *Chaiken*

**For. 289. Interpretation of Aerial Photographs.** Principles of aerial photo-

graphy and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. Corequisite: Forestry 281 or equivalent. 2 units. *Chaiken (Summer Session)*

**E.S. 349. Wildland and Wildlife Management.** The paradox of managed natural systems is considered in the context of plant, animal, and human population dynamics. Topics include vegetation management, wildlife management, and wilderness recreation management, including camping, backpacking, hunting, and fishing. Special attention is paid to wildland preserve and open space planning. 3 units. *Staff*

**For. 382. Legal Aspects of Forestry.** A seminar on certain state and federal laws pertinent to the management of forests: land ownership, trespass, public liability, timber contracts, labor relations, and use of pesticides. 1 unit. *Chaiken*

**For. 386. Seminar in Forest Management.** Examination and analysis of techniques employed in the management of industrial and public forests, particularly in the south; discussion of problems of large scale intensive forest management. Prerequisites: Forestry 244, 281, and 377 or equivalent. 1 unit. *Chaiken*

Related courses in other departments include—*Business Administration*: Theory of Firm, Organization Theory, Information Systems, The Firm in Society; *Political Science*: Public Administration; *Social Science*: Social Stratification, Industrial Sociology.

## Statistics and Operations Research

**For. 250. Biometry.** Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. 3 units. *Yandle*

**For. 251. Theory and Methods for Sampling Biological Populations.** Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. 3 units. *Yandle*

**For. 253. Computer Science in Natural Resources.** Introduction to the organization of information storage and retrieval systems. Extensive use of Fortran (WATFIV) programming and statistical packages (SAS, TSAR) in resource and environmental decision making. 3 units. *Rajagopal*

**For. 258. Quantitative Analysis in Resource Management.** Mathematical model formulation and analysis in resource and environmental decision making. Includes a survey of applications of linear programming, dynamic programming, CPM-PERT, inventory and statistical quality control in the resource sciences. Use of APL and MPS programming systems. 3 units. *Rajagopal*

**For. 352. Theory and Applications of Linear Statistical Models.** Theoretical development of the general linear statistical model, together with extensions to accommodate linear approximation of nonlinear cases. Curve-fitting techniques are developed, with emphasis on applications to natural phenomena. Prerequisite: consent of the instructor. 3 units. *Yandle*

**For. 353. Design and Analysis of Experiments.** Extension of the theory of estimation and testing for general linear models to include the less than full rank case. Experimental design models such as factorial and incomplete block models and developed as special cases of the general theory. Emphasis is placed on field and laboratory designs, together with appropriate computerized analysis techniques. Prerequisite: Forestry 352. 3 units. *Rajagopal*

**E.S. 354. Biological and Resource System Simulation.** (See description under "Ecology" above.)

Related courses in other departments include—*Mathematics*: Calculus, Numerical Analysis, Complex Analysis, Non-parametric, Statistics, Probability, Applied Mathematical Statistics, Stochastic Processes, Multivariate Statistics; *Economics*: Econometrics, Quantitative Analysis.

## Special Studies and Research

**For. 299. Special Studies in Forestry.** Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

**E.S. 299. Independent Projects in Environmental Studies.** Work at the senior-graduate level to meet the needs of individual students in several areas of environmental studies. Credits and hours to be arranged. *Staff*

1. Environmental Planning. *Staff*
2. Environmental Economics. *Convery*
3. Applied Ecology. *Wuenschel*
4. Environmental Education. *Wuenschel*
5. Environmental Communication and Media. *Wuenschel*
6. Environmental Ethics and Values. *Wuenschel*
7. Environmental Design. *Staff*
8. Environmental Policy. *Convery*
9. Environmental Systems Analysis. *Rajagopal*

**For. 301, 302. Advanced Studies in Forestry.** Work on the advanced graduate level to meet the needs of individual students is offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

**E.S. 301, 302. Advanced Projects in Environmental Studies.** Independent work at the advanced graduate level in areas designated under Environmental Studies 299. *Staff*

**For. 357, 358. Research in Forestry.** Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged. *Staff*

1. *Forest Ecology*. Prerequisite: Environmental Studies 243 or equivalent. *Wuenschel*
2. *Forest Soils*. Prerequisite: Forestry 261 or equivalent. *Ralston*
3. *Silviculture*. Prerequisites: Environmental Studies 243 and Forestry 244 or equivalents. *White*
4. *Forest Management*. Prerequisite: Forestry 281 or equivalent. *Chaiken*
5. *Forest Economics*. Prerequisite: Forestry 270 or equivalent. *Convery*
6. *Wood Anatomy and Properties*. Prerequisites: Forestry 241 and 206 or equivalents. *Philpott*
7. *Forest Mensuration and Biometry*. Prerequisites: Forestry 250 and 352 or equivalents. *Yandle*
8. *Forest Entomology*. Prerequisite: Forestry 230 or equivalent. *Anderson*
9. *Forest Operations Research*. Prerequisite: consent of instructor. *Rajagopal*
10. *Dendrology*. Prerequisite: Forestry 241 or equivalent. *White*
11. *Forest-Tree Physiology*. Prerequisites: plant physiology and plant or forest ecology. *Barnes and Hellmers*
12. *Forest Pathology*. Prerequisites: plant physiology and Forestry 223 or equivalents. *Stambaugh*
13. *Forest Meteorology and Hydrology*. Prerequisites: Forestry 203, 342, or equivalents. *Knoerr*
14. *Forest Biochemistry*. Prerequisites: plant physiology and organic chemistry. *Barnes*
15. *Regional Land Use Planning*. Prerequisites: Environmental Studies 337 and 340. *Staff*
16. *Environmental Studies*. Prerequisites: consent of instructor. *Staff*

**368. Field Seminars.** Field studies, consultations, and visits to areas of interest during spring vacation period, or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. *Staff*



# Numerical Listing of Courses

## Forestry Courses

- 152. Conserving Natural Resources. 3 units
- 200. Careers in Natural Resources. No credit
- 203. General Meteorology. 3 units
- 204. Microclimatology. 3 units
- 205. Tree Growth and Development. 3 units (Summer Session)
- 206. Anatomy of Woody Plants. 4 units
- 207. Chemistry of Woody Tissues. 3 units



- 208. Physiology of Wood Formation. 3 units
- 210. Forest Utilization. 1 unit, seminar only; 2 units, course and seminar
- 215. Air Pollution Meteorology. 3 units
- 216. Watershed Hydrology. 3 units
- 217. Environmental Instrumentation. 4 units
- 222. Biology of Forest Insects and Diseases. 4 units
- 223. Forest Pathology. 4 units
- 225. Chemical Aspects of Forest Protection. 3 units
- 230. Forest Entomology. 4 units
- 233. General Entomology. 4 units
- 241. Dendrology. 3 units (Summer Session)
- 244. Theory and Practice of Silviculture. 2 units; 3 units with laboratory
- 245. Management of Small Woodlands. 3 units
- 247. Forest Recreation and Landscape Management. 3 units
- 248. Forest Regeneration. 3 units
- 250. Biometry. 3 units
- 251. Theory and Methods for Sampling Biological Populations. 3 units
- 253. Computer Science in Natural Resources. 3 units
- 256. Forest Measurements. 4 units (Summer Session)
- 258. Quantitative Analysis in Resource Management. 3 units
- 261. Soils and Forest Resources. 3 units
- 269. Resource Economics and Policy. 3 units
- 270. Economics of Forestry. 3 units
- 272. Business Policy. 3 units
- 277. Seminar in Natural Resource Allocation and Efficiency. 1 unit
- 281. Forest Management. 3 units
- 283. Fire Behavior and Use. 2 units
- 289. Interpretation of Aerial Photographs. 2 units (Summer Session)
- 292. Microtechnique of Woody Tissue. 3 units
- 299. Special Studies in Forestry. Credits to be arranged
- 301-302. Advanced Studies in Forestry. Credits to be arranged
- 304. Atmospheric Turbulence and Diffusion. 3 units
- 305. Forest Biochemistry. 3 units
- 306. Dynamics of Local Atmospheric Motion. 3 units
- 321. Phytopathological Technique in Forestry. 4 units
- 322. Microbiology of Forest Soils. 4 units
- 331. Toxicology of Insecticides. 3 units
- 332. Ecology of Forest Insects. 3 units; 4 units with laboratory
- 335. Entomological Research Techniques. 1 unit
- 342. Hydrologic Process. 3 units
- 344. Micrometeorology and Biometeorology Seminar. 2 units
- 352. Theory and Applications of Linear Statistical Models. 3 units
- 353. Design and Analysis of Experiments. 3 units
- 357-358. Research in Forestry. Credits to be arranged
- 362. Forest Soil Physics. 3 units
- 364. Soil Classification and Mapping. 3 units
- 366. Forest Soil Fertility. 3 units
- 368. Field Seminars. Credits to be arranged
- 378. Seminar in Forest Economics. 2 units
- 382. Legal Aspects of Forestry. 1 unit
- 385. Seminar in Forest Protection. 1 unit
- 386. Seminar in Forest Management. 1 unit

#### Environmental Studies Courses

- 243. Natural Resource Ecology. 3 units
- 273. Economics and Environmental Quality. 3 units
- 299. Independent Projects in Environmental Studies. Credits to be arranged
- 301-302. Advanced Projects in Environmental Studies. Credits to be arranged
- 337. Ecological Analysis for Environmental Management. 3 units
- 340. Ecology and Land Use Planning. 3 units
- 341. Ecological Principles in Environmental Management. 3 units
- 346. Seminar in Environmental Policy. 1 unit
- 347-348. Natural Resource Ecology—Environmental Management Seminar. Credits to be arranged
- 349. Wildland and Wildlife Management. 3 units
- 354. Biological and Resource System Simulation. 3 units

# Appendix

## ENROLLMENT

### Registered for the Master of Forestry Degree

Adams, James John (B.S., Elizabethtown College), Elysburg, Pennsylvania  
Albrecht, Michael Howard (Donae College), Hickman, Nebraska  
Allen, David Leslie (B.Sc., University of Louisville), Louisville, Kentucky  
Anderton, David Edward, Jr. (University of Richmond), Williamsburg, Virginia  
Bailey, Susan Elizabeth (Gettysburg College), Harrisburg, Pennsylvania  
Beatty, Jerome Shalley (B.A., Wabash College), Cranford, New Jersey  
Boone, Andrew Justus (B.S., Newberry College), Irmo, South Carolina  
Brown, Charles Richard (B.S., Elizabethtown College), Gibsonsia, Pennsylvania  
Carothers, William Albert (B.A., Gettysburg College), Carlisle, Pennsylvania  
Carroll, Francis Joseph (B.A., Bucknell University), Glenolden, Pennsylvania  
Colgan, Thomas John (B.S., Duke University), Rochester, New York  
Considine, Thomas J., Jr. (B.S., Rutgers University), Cherry Hill, New Jersey  
Crew, John Asprey (B.A., Elizabethtown College), Broomall, Pennsylvania  
Crosby, Douglas McDonald (Juniata College), Chalfont, Pennsylvania  
Curcio, Gary Matthew (B.S., Albright College), Brooklyn, New York  
Davies, Mark Donald (Lycoming College), Allentown, Pennsylvania  
Dorset, Richard David (Lebanon Valley College), Dover, Pennsylvania  
Easter, Geoffrey Brent (B.S., Ohio University), Franklin Furnace, Ohio  
English, James Thomas (B.A., Johns Hopkins University), Cincinnati, Ohio  
Evans, David Wayne (Duke University), Springfield, Virginia  
Farrell, Peter (Franklin and Marshall College), Oceanside, New York  
Florschutz, Henry Charles (B.A., Wittenberg University), Bronx, New York  
Fraedrich, Bruce Robert (B.A., Newberry College), Oceanside, New York  
Gallemore, Paul Stanley (William Jewell College), Kansas City, Missouri  
Gearhart, Brent Coulter (B.A., Gettysburg College), Reedsville, Pennsylvania  
Ghent, John Hennessey (B.A., Catawba College), Alexandria, Virginia  
Griswold, Mona (Drew University), Croton-on-Hudson, New York  
Hawthorne, John Elliott (Denison University), Chicago, Illinois  
Hearnberger, John Charles (B.A., Hendrix College), Little Rock, Arkansas  
Highsmith, George William (University of Richmond), Thomasville, North Carolina  
Holland, Bruce George (B.A., Albright College), Shoemakersville, Pennsylvania  
Howard, Theodore Samuel (B.S., Lincoln Memorial University), Lebanon, Ohio  
Hsiao, Chiu-fang (B.S., National Taiwan University), Taipei, Taiwan  
Huff, Mark Hamilton (B.A., Albright College), Chappaqua, New York  
Johansen, John Ramsey (B.S., Elizabethtown College), Ridgewood, New Jersey  
Johnson, Edward Leonard (B.A., Gettysburg College), Springfield, Pennsylvania  
Keith, Sherry Lynn (B.A., Elizabethtown College), Glen Mills, Pennsylvania  
Klapproth, Michael Alan (Wittenberg University), Cincinnati, Ohio  
Kucera, Robert Clarence (Kent State University), Kent, Ohio  
Knutson, Gary Robert (Davis and Elkins College), Brookside, New Jersey  
Lerich, Brian Walter (B.A., Yale University), White Plains, New York  
LoGrasso, Frank Anthony (B.B.A., Cleveland State University), Mayfield Heights, Ohio  
McNamara, Edward Paul (B.S., Duke University), Oxon Hill, Maryland  
Meek, Richard Alan (Elizabethtown College), Catawissa, Pennsylvania  
Melosh, William Donald (B.S., Duke University), Upper Montclair, New Jersey  
Merrigan, Gerald Paul (Rollins College), Maitland, Florida  
Moran, Theodore Stanley (Davis and Elkins College), Chatham, New Jersey  
Moyer, Michael John (B.S., Albright College), Reading, Pennsylvania  
Myers, Gary Alan (B.B.A., Deland University), Green Cove Springs, Florida  
Nenevajska, Peter Bruce (B.A., Wittenberg University), Pittsburgh, Pennsylvania  
Oak, Steven Walter (B.S., Juniata College), Lancaster, Pennsylvania  
Pence, John Stephen (B.S., Davis and Elkins College), McGaheysville, Virginia  
Rathburn, Francis Arthur (B.S., High Point College), Pompton Plains, New Jersey  
Schliapin, Nicholas Peter (B.A., Gettysburg College), Washington, D. C.  
Schmit, David Anthony (Duke University), Auburn, Pennsylvania  
Seiler, Gary Iorwerth (B.S., Albright College), Schaefferstown, Pennsylvania  
Shelburne, Victor Balmer (B.S., Duke University), Stamford Connecticut  
Shelton, Lyle Wayne (Indiana Central College), Kennard, Indiana  
Skove, David James (B.S., The College of William and Mary), Williamsburg, Virginia  
Smith, Phillip Gregory (B.S., University of Massachusetts), North Dighton, Massachusetts



Stoner, Raymond Ralph (Youngstown State University), New Castle, Pennsylvania  
 Stuart, John Jarrell (B.A., Catawba College), Cherry Hill, New Jersey  
 Suppiger, Gerhart Schott, III (B.A., Duke University), Belleville, Illinois  
 Surrency, Ellen Gwinn (Duke University), Media, Pennsylvania  
 Taaffe, Kenneth Edward, Jr. (B.A., Duke University), Trenton, New Jersey  
 Thompson, Edward Claude (B.S., Duke University), Silver Spring, Maryland  
 Timmons, Steven Craig (Elizabethtown College), North Wales, Pennsylvania  
 Tunis, Catherine Susan (B.A., Kean College), Linden, New Jersey  
 Twardus, Daniel Bruce (B.A., Gettysburg College), Marlboro, New Jersey  
 Underhill, Roy Egerton (B.F.A., University of North Carolina, Chapel Hill), Washington, D. C.  
 Webb, Roger Stuart (A.B., The College of William and Mary), Richmond, Virginia  
 Wilson, Jan Robert (Miami University), Mount Vernon, Ohio  
 Wilson, Jon Stephen (B.S.F., West Virginia University), Columbus, Ohio  
 Yann, Ronald Jesse (Willamette University), Santee, California  
 Yohn, Cheyrl Kay (Juniata College), Altoona, Pennsylvania

### Registered for the Master of Environmental Management Degree

Alexander, Lawrence Frederick (B.A., Duke University), Sanford, North Carolina  
 Baum, George Jürgen (B.A., University of North Carolina, Chapel Hill), Carrboro, North Carolina  
 Blakely, Carol Ann (B.A., Middlebury College), Canton, Massachusetts  
 Campbell, Thomas Henry, Jr. (B.A., Duke University), Malvern, Pennsylvania  
 Chantry, William Amdor, Jr. (B.S., Duke University), Kinston, North Carolina  
 Coffey, Stephen Dana (B.S., Elizabethtown College), Wellesley, Massachusetts  
 Croxton, Cynthia Jean (B.S., Duke University), Coopersburg, Pennsylvania  
 Deyle, Robert Eaton (A.B., Dartmouth College), Jacksonville, Florida  
 Diaz-Barrios, Amelia Odette (B.S.A., University of Puerto Rico), Caguas, Puerto Rico  
 Elliott, Lee Flagg (B.A., Hollins College), Charles Town, West Virginia  
 Fausold, Charles James (B.A., Gettysburg College), Seneca Falls, New York  
 Faverty, Thomas Lee (Duke University), Plantation, Florida  
 Feltman, John David (B.S., West Georgia College), Mableton, Georgia  
 Fish, Lincoln Curtis (B.A., Lycoming College), Needham, Massachusetts  
 Forbes, Norman Robert (B.A., Gettysburg College), Yonkers, New York  
 Gruber, Peter Jonathan (B.A., Syracuse University), Sea Cliff, New York  
 Hall, William Scott (B.A., Duke University), Chevy Chase, Maryland  
 Harrison, Edward Calhoun (B.A., Duke University), Spartanburg, South Carolina  
 Hodges, James Alan (B.Sc., University of Western Ontario), London, Ontario, Canada  
 Hryharow, John Ellis (B.A., University of North Carolina, Chapel Hill), Beaufort, South Carolina  
 Jakubowicz, Steven Paul (B.A., Franklin and Marshall College), Fair Haven, New Jersey  
 Lesesne, John Webb (B.S., Wake Forest University), Spartanburg, South Carolina  
 McCrodden, Brian James (B.S., United States Military Academy, West Point), Bethel, Maine  
 McKimm, Robert John (Dip. For., Victorian School of Forestry; B.Sc., Melbourne University), Victoria, Australia  
 Menetrez, Marc Yves (B.S., Long Island University), Brooklyn, New York  
 Metzger, John Bradley (B.S., West Virginia Wesleyan College), LaVale, Maryland  
 Miller, Wesley Cluster (B.A., Indiana University), Boonville, Indiana  
 Minis, Henry Philip, Jr. (B.S., University of North Carolina, Chapel Hill), Chilmark, Massachusetts  
 Northup, James Michael (Wake Forest University), Minnville, New York  
 Oakman, Mark Whipple (B.A., Whittenberg University), Durham, North Carolina  
 O'Mara, Marc James (B.A., Gettysburg College), Silver Spring, Maryland  
 Palmer, Walter Arthur (Juniata College), Sharon, Massachusetts  
 Pappalardo, Peter Eric (Juniata College), Stroudsburg, Pennsylvania  
 Parker, Francis Marion, Jr. (B.A., University of North Carolina, Chapel Hill), Asheville, North Carolina  
 Peacock, Stuart Lance (B.A., University of North Carolina, Chapel Hill), Chapel Hill, North Carolina  
 Pelland, Kirk Patrick (A.B., Duke University; A.B., University of Akron), Akron, Ohio  
 Rader, Charles Whitener (B.A., Duke University), Durham, North Carolina  
 Rader, Janet Kilby (B.S., Duke University), Durham, North Carolina  
 Rosenfeld, William Spencer (B.S., Tulane University), Parma, Ohio  
 Smith, Stuart Gage (B.A., Duke University), Camden, Maine  
 Stevenson, Helen Alice (B.S., Tulane University), Georgetown, Texas  
 Tolley, Richard Treherne (B.S., Duke University), Hyattsville, Maryland  
 Weitzel, Pamela Lynn (A.B., Mount Holyoke College), Springfield, Pennsylvania  
 Whiteside, Muriel Grant (B.S., Duke University), Old Greenwich, Connecticut  
 Willett, Geoffrey Seymour (B.A., Gettysburg College), Glen Rock, New Jersey  
 Worthington, Thomas Charles (A.B., Duke University), Princeton, New Jersey

### Students in the Department of Forestry and Environmental Studies in the Graduate School

Airola, Teuvo Mathias (B.S.; M.C.R.P.; M.S., Rutgers University), Dover, New Jersey  
Barnard, Edward Livingston (B.S., University of Vermont; M.S., Duke University), Shoreham, Vermont  
Bates, Maynard Ewin (B.A., Ohio University; M.S., Rutgers University), Millersburg, Ohio  
Binstock, David Aaron (A.B., Hunter College; M.S., University of Michigan), Bronx, New York  
Cheeseman, John McPherson (B.S., Duke University), Hudson, Ohio  
Cordell, Charles Edward (B.S., North Carolina State University; M.S., Duke University), Asheville, North Carolina  
DeNitto, Gregg Allan (B.A., Thiel College), Glen Burnie, Maryland  
Duda, Alfred Michael (B.S., Boston College), Pittsfield, Massachusetts  
Gollob, Lawrence (B.S., State University of New York, Stonybrook), Yonders, New York  
Keenan, Russell Edward (B.S., Bates College), Bradford, Connecticut  
Lorimer, Craig Gordon (B.A., Colby College), North Windham, Maine  
Meadors, Merewyn Davis (B.S.; B.A., Morris Harvey College; M.S., Marshall University), St. Albans, West Virginia  
Methven, Ian Robert (B.Sc.F., University of New Brunswick), Fredricton, New Brunswick, Canada  
Mowry, Fred Lear (B.S., Syracuse University), Syracuse, New York  
Nguyen Van Phu (For. Eng., College of Forestry, Viet Nam; M.F., Duke University), Saigon, Viet Nam  
Nichols, Rosemary (B.A., Randolph-Macon College; M.S., University of Michigan, Ann Arbor), Chatham, Virginia  
Olmsted, Ingrid Christene (B.S., Brandeis University), Acton, Massachusetts  
P  ch, Gyula (B.S.F., University of British Columbia; M.F., Yale University; M.Sc., University of Guelph), Ottawa, Ontario, Canada  
Roberts, Stephen Winston (B.S.; M.S., San Diego State University), La Jolla, California  
Robbins, Mary Kathryn (B.A., Denison University), Westport, Connecticut  
Rush, Steven Gilbert (B.S., Emory University), Chamblee, Georgia  
Saunders, Paul Richard (B.S.; M.S., Purdue University), Kokomo, Indiana  
Shaffer, Mark Leslie (B.S., Indiana University of Pennsylvania), Mahaffey, Pennsylvania  
Sigmon, John Thomas (A.B., Duke University), Charlotte, North Carolina  
Vasievich, Joseph Michael (B.A., Franklin and Marshall College; M.F., Duke University), Eaton, Pennsylvania



## DEGREES CONFERRED 1974-1975

### Master of Forestry

George Richard Cline  
Charles Walter Dull  
Jerry Francis Epstein  
William Alexander Graham III  
Rickey Allen Hamilton  
Charles Thomas Johnson  
Robert M. Jolley  
John R. Kendall

Larry George King  
Delbert R. Mead  
Christopher Peter Olson  
Gary Richard Peiffer  
Chad Burgess Pilling  
Lewis Douglas Prather, Jr.  
Robert Hamilton Stoddard  
Franklin Owen Wicks, Jr.

### Master of Environmental Management

Elisabeth Chafee Heyward  
Leigh Robinson Kerr  
Robert Jay Klein  
Sue Ann Kulick  
Anthony L. Mandracchia  
Robert L. Moul

Raymond George Pfortner  
Danny A. Ross  
Chandler Craig Smith  
Theodore R. Walton  
David Forrest Weaver  
Juliann Whelan

### Doctor of Philosophy

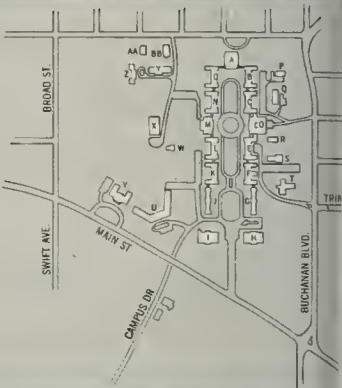
Virgil Clark Baldwin, Jr. (B.S., University of Utah; M.S., Colorado State University), Dissertation: "Comparison and Evaluation of Methods for Determining Pattern in Stationary Populations."  
George M. Blakeslee (B.S., Albright College; M.F., Duke University), Dissertation: "Basidiospore Germination and Function in Ectomycorrhizal Synthesis by Certain Members of the Agaricales."  
Hsu-Ho Chung (B.S., National Taiwan University; M.S., Duke University), Dissertation: "Growth, Biochemical Changes, and Photosynthate Allocation in Shoots of *Pinus taeda* L."  
Alex B. Cole (B.S., M.S., University of Missouri), Dissertation: "Forest Products Industries and the North Carolina Economy."  
Charles Arthur Gresham (B.S., University of Georgia; M.S., Duke University), Dissertation: "Stomatal Resistance in a Loblolly Pine Plantation."



# MAP OF DUKE UNIVERSITY

## East Campus

- |   |                         |    |                      |
|---|-------------------------|----|----------------------|
| A | Baldwin Auditorium      | O  | Pegram House         |
| B | Bassett House           | P  | Duke Press           |
| C | Brown House             | Q  | Infirmary            |
| D | Union Building          | R  | Ark                  |
| E | Faculty Apartments      | S  | Crowell Building     |
| F | Art Museum, Geology     | T  | Epworth Inn          |
| G | Aycock House            | U  | Gilbert-Addams House |
| H | East Duke Building      | V  | Southgate Hall       |
| I | West Duke Building      | W  | Campus Center        |
| J | Jarvis House            | X  | Woman's College      |
| K | Carr Building           |    | Gymnasium            |
| L | Giles House             | Y  | Asbury Building      |
| M | Woman's College Library | Z  | Bivins Building      |
| N | Alsapugh House          | AA | Art Building         |
|   |                         | BB | Branson Building     |



## West Campus

- |   |                        |   |                        |   |                    |    |                     |
|---|------------------------|---|------------------------|---|--------------------|----|---------------------|
| A | Duke Chapel            | H | Hospital Main Entrance | O | Craven Quadrangle  | V  | Card Gymnasium      |
| B | Divinity School        | I | Gerontology, D & T,    | P | Wannamaker Hall    | W  | Indoor Stadium      |
| C | Gray Building          |   | Clinical Research      | Q | Crowell Quadrangle | X  | School of Law       |
| D | Perkins Library        | J | Duke Hospital          | R | Clock Tower Court  | Y  | Gross Chemical Lab  |
| E | Language Center        | K | Sociology, Psychology  | S | Kilgo Quadrangle   | Z  | Biological Sciences |
| F | Old Chemistry Building | L | Social Sciences        | T | Union Building     | AA | Plant Environment   |
| G | Owson Building         | M | Allen Building         | U | Flowers Building   |    | Laboratory          |
|   | School of Medicine     | N | Few Quadrangle         |   | Page Auditorium    | BB | Physics Building    |
- 
- |                    |                        |    |                        |
|--------------------|------------------------|----|------------------------|
| CC                 | Nuclear Laboratory     | GG | Nanaline H. Duke M     |
| DD                 | School of Engineering  |    | Sciences Building      |
| EE                 | Army Research          | HH | Warehouse, Shop        |
| FF                 | Medical Center Rese    | II | Belt Building          |
|                    | Buildings              | JJ | Hanes House            |
| GG                 | Nanaline H. Duke M     |    | School of Nursing      |
| HH                 | Warehouse, Shop        | KK | Hanes House Annex      |
| II                 | Belt Building          | LL | Pickens Rehabilitation |
| JJ                 | Hanes House            |    | Center                 |
| KK                 | Hanes House Annex      | MM | Graduate Center        |
| LL                 | Pickens Rehabilitation | NN | Alumni House           |
|                    | Center                 | OO | Commonwealth-Stu       |
| MM                 | Graduate Center        |    | Center                 |
| NN                 | Alumni House           | PP | Personnel Office       |
| OO                 | Commonwealth-Stu       | QQ | International House    |
|                    | Center                 | RR | Personnel Office       |
| PP                 | Personnel Office       | SS | Education Improver     |
| QQ                 | International House    |    | Program,               |
| RR                 | Personnel Office       |    | A Better Chance Pr     |
| SS                 | Education Improver     |    | Center                 |
|                    | Program,               | TT | International Stud     |
| A Better Chance Pr |                        |    | Center                 |
| Center             |                        | UU | Campus Stores Off      |
| TT                 | International Stud     | VV | Office of Institution  |
| Center             |                        |    | Advancement            |
| UU                 | Campus Stores Off      | WW | Information Service    |
| VV                 | Office of Institution  |    | Visitors Bureau        |
|                    | Advancement            | XX | Admissions Office      |
| WW                 | Information Service    | YY | Edens Quadrangle       |
| XX                 | Admissions Office      | ZZ | Wade Stadium           |
| YY                 | Edens Quadrangle       |    |                        |
| ZZ                 | Wade Stadium           |    |                        |









# Bulletin of Duke University

Summer  
Session

1976





# Bulletin of Duke University

Summer Session

1976

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EDITOR  
Sharon Adler  
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Elizabeth Matheson

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## Contents

<b>Officers of the University</b>	iv
<b>Officers of the Summer Session</b>	iv
<b>The Summer Session Faculty</b>	v
<b>General Information</b>	viii
<b>Program Information</b>	2
Undergraduate Study	3
Divinity School Studies	3
Graduate Study	3
Postdoctoral Research	5
<b>Special and Cooperative Programs</b>	6
Cooperative Program	7
Special Conferences and Courses	7
<b>Resources for Study</b>	10
<b>Student Life</b>	12
Living Accommodations	13
Services Available	13
Student Activities	14
<b>Admission</b>	16
<b>Financial Information</b>	20
Tuition and Fees	21
Living Accommodations	22
Student Aid	22
<b>Registration and Regulations</b>	24
Academic Regulations	28
Motor Vehicle Regulation	31
<b>Courses of Instruction</b>	32
Calendar of the Summer Session	66
Application	67

## Officers of the University Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*  
John O. Blackburn, Ph.D., *Chancellor*  
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Olan Lee Petty, Ph.D., *Director of the Summer Session*  
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Judith M. Schwartz, B.A., *Assistant to the Dean of the School of Nursing*  
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Howard A. Strobel, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*  
Gerald L. Wilson, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*  
Ellen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*  
Thomas A. Langford, Ph.D., *Dean of the Divinity School*  
Charles William Ralston, Ph.D., *Dean of the School of Forestry and Environmental Studies*  
Charles M. Harman, Ph.D., *Associate Dean of the Graduate School*  
William Katzenmeyer, Ed.D., *Associate Dean of the Graduate School*  
John D. Costlow, Jr., Ph.D., *Director of Duke Marine Laboratory*

Robert Young, B.D., *Minister to the University*  
 James Benjamin Smith, Jr., M.S.M., *Director of Chapel Music and Choral Music*  
 Walter Scott Persons, A.B., *Recreation Supervisor for the Summer Session*  
 Lawrence W. Smith, Jr., B.A., *Director of Housing Management*  
 Paul R. Benton, *Manager of Residence Halls*  
 Wayland Hedgepeth, B.B.A., *Manager of Apartments and Property*  
 Winifred R. Brogden, *Administrative Secretary of the Summer Session*

## The Summer Session Faculty

Adams, Anne H., Ed.D., *Professor of Education*  
 Aderman, David, Ph.D., *Assistant Professor of Psychology*  
 Alt, Arthur Tilo, Ph.D., *Assistant Professor of German*  
 Anderson, Carl L., Ph.D., *Professor of English*  
 Apte, Mahadev L., Ph.D., *Associate Professor of Anthropology*  
 Baier, Rodger W., Ph.D., *Assistant Professor of Chemistry*  
 Bailey, Lloyd R., Ph.D., *Associate Professor of Old Testament*  
 Barber, Richard T., Ph.D., *Associate Professor of Zoology*  
 Barnes, Robert D., Ph.D., *Visiting Professor of Biology*  
 Barnes, Robert L., Ph.D., *Professor of Forest Biochemistry*  
 Bassett, Frank H. III, M.D., *Professor of Orthopaedics*  
 Beecher, Robert M.A., *Instructor in Anthropology*  
 Bessent, Helga W., M.A., *Assistant Professor of German*  
 Bland, Kalman P., Ph.D., *Assistant Professor of Religion*  
 Blankley, William F., Ph.D., *Assistant Professor of Botany*  
 Bolnick, Bruce R., Ph.D., *Visiting Assistant Professor of Economics*  
 Bookhout, Cazlyn Green, Ph.D., *Professor of Zoology*  
 Boudreaux, Gregory, Ph.D., *Visiting Assistant Professor of Philosophy*  
 Bradley, David G., Ph.D., *Professor of Religion*  
 Bronfenbrenner, Martin, Ph.D., *William R. Kenan, Jr. Professor of Economics*  
 Brundage, Dorothy J., M.N., *Assistant Professor of Nursing*  
 Bryan, Anne-Marie, M.A.T., *Assistant Professor of Romance Languages*  
 Buehler, Albert G., M.A., *Associate Professor of Physical Education*  
 Burford, Walter W., S.T.M., *Assistant Professor of Religion*  
 Butters, Ronald R., Ph.D., *Assistant Professor of English*  
 Carbone, Peter, Ed.D., *Associate Professor of Education*  
 Carson, Robert C., Ph.D., *Professor of Psychology*  
 Cartwright, William H., Ph.D., *Professor of Education*  
 Caserta, Ernesto G., Ph.C., *Assistant Professor of Romance Languages*  
 Casson, Ronald, Ph.D., *Assistant Professor of Anthropology*  
 Cell, John E., Ph.D., *Associate Professor of History*  
 Chaiken, Leon E., M.F., *Professor of Forest Management*  
 Christensen, Norman L., Jr., Ph.D., *Assistant Professor of Botany*  
 Clayton, Bruce Lynn, Ph.D., *Visiting Associate Professor of History*  
 Clum, John M., Ph.D., *Assistant Professor of English*  
 Colver, Robert Merle, Ed.D., *Associate Professor of Education*  
 Connolly, John L. Jr., Ph.D., *Visiting Assistant Professor of Art*  
 Corless, Roger J., Ph.D., *Assistant Professor of Religion*  
 Cox, James L., Ph.D., *Visiting Professor of Biology*  
 Cutler, Stephen J., Ph.D., *Visiting Associate Professor of Sociology*  
 Davis, Lucy Tolbert, Ed.D., *Associate Professor Education*  
 De Lucia, Frank, Ph.D., *Assistant Professor of Physics*  
 DeNeef, A. Leigh, Ph.D., *Assistant Professor of English*  
 Di Bona, Joseph, Ph.D., *Associate Professor of Education*  
 Duffey, Bernard I., Ph.D., *Professor of English*  
 Duke, Kenneth Lindsay, Ph.D., *Associate Professor of Anatomy*  
 Durden, Robert F., Ph.D., *Professor of History*  
 Eaglen, Robert H., M.A., *Instructor in Anthropology*  
 Evans, Lawrence, Ph.D., *Associate Professor of Physics*  
 Ferguson, Oliver W., Ph.D., *Professor of English*  
 Fish, Peter G., Ph.D., *Associate Professor of Political Science*  
 Flowers, Anne, Ed.D., *Professor of Education*  
 Forward, Richard, Ph.D., *Assistant Professor of Zoology*  
 Fowlie, Wallace, Ph.D., *James B. Duke Professor of Romance Languages*  
 Friedrich, John, Ph.D., *Professor of Physical Education*

Garcı-Gomez, Miguel, Ph.D., *Associate Professor of Romance Languages*  
 Gavins, Raymond, Ph.D., *Assistant Professor of History*  
 Gehman, W. Scott, Jr., Ph.D., *Professor of Psychology in Education*  
 Gelein, Janet Gay, M.S., *Assistant Professor of Nursing*  
 Gill, Robert, Ph.D., *Part-time Instructor in Political Science*  
 Goalstone, Clifford, Ph.D., *Visiting Lecturer in Economics*  
 Hall, Hugh M., Ph.D., *Professor of Political Science*  
 Hammond, Michael, Ph.D., *Visiting Assistant Professor of Anthropology*  
 Harris, Betty, M.F.N., *Lecturer in Nursing*  
 Henry, James D., M.M., *Assistant Professor of Music*  
 Heron, S. Duncan, Jr., Ph.D., *Professor of Geology*  
 Hogue, Carol C., Ph.D., *Assistant Professor of Nursing and Assistant Professor of Community Health Sciences*  
 Hollyday, Frederic B. M., Ph.D., *Professor of History*  
 Hurlburt, Allan S., Ph.D., *Professor of Education*  
 Jeffs, Peter Walter, Ph.D., *Professor of Chemistry*  
 Johnson, Terry Walter, Jr., Ph.D., *Professor of Botany*  
 Jones, Barney L., Ph.D., *Professor of Religion*  
 Jones, Buford, Ph.D., *Associate Professor of English*  
 Kalat, James, Ph.D., *Assistant Professor of Psychology*  
 Lakin, Martin, Ph.D., *Professor of Medical Psychology in Department of Psychiatry and Professor of Psychology*  
 Landeira, Richard, Ph.D., *Assistant Professor of Romance Languages*  
 Lawrence, Bruce B., Ph.D., *Associate Professor of Religion*  
 Leach, Richard H., Ph.D., *Professor of Political Science and Lecturer in Education*  
 LeBar, John, Ed.D., *Assistant Professor of Physical Education*  
 Lerner, Warren, Ph.D., *Professor of History*  
 Lockhead, Gregory, Ph.D., *Professor of Psychology*  
 Ludt, Robert, Ph.D., *Visiting Assistant Professor of Chemistry*  
 Maves, David W., A.Mus.D., *Assistant Professor of Music*  
 Martin, David V., Ed.D., *Associate Professor of Education*  
 Mauskopf, Seymour, Ph.D., *Associate Professor of History*  
 Monsman, Gerald C., Ph.D., *Associate Professor of English*  
 Mueller, Julia W., M.A., *Professor of Music*  
 Myers, Roderick W., M.A., *Instructor in Physical Education*  
 Nelson, Paul David, Ph.D., *Visiting Assistant Professor of History*  
 Nygard, Holger, Ph.D., *Professor of English*  
 Oates, John F., Ph.D., *Professor of Classical Studies*  
 Patrick, Merrell Lee, Ph.D., *Associate Professor of Computer Science*  
 Persons, Walter S., A.B., *Associate Professor of Physical Education*  
 Petty, Olan Lee, Ph.D., *Professor of Education*  
 Pittillo, Robert A., Jr., Ed.D., *Associate Professor of Education*  
 Pilkey, Orrin H., Ph.D., *Professor of Geology*  
 Portes, Alejandro, Ph.D., *Professor of Sociology*  
 Pratt, Sheila, *Instructor in Art*  
 Pratt, Vernon, M.F.A., *Assistant Professor of Art*  
 Price, David E., Ph.D., *Associate Professor of Political Science and Policy Sciences*  
 Price, James L., Jr., Ph.D., *Professor of Religion*  
 Reiss, Edmund, Ph.D., *Professor of English*  
 Riebel, John D., M.A., *Assistant Professor of Physical Education*  
 Ripley, Dana P., Ph.D., *Associate Professor of Romance Languages*  
 Ritz, Michael, B.S., *Lecturer in Physical Education*  
 Robinson, Hugh C., Ph.D., *Professor of Physics*  
 Salamon, Lester M., Ph.D., *Assistant Professor of Political Sciences and Policy Sciences*  
 Sanford, David, Ph.D., *Associate Professor of Philosophy*  
 Searles, Richard, Ph.D., *Associate Professor of Botany*  
 Shuman, R. Baird, Ph.D., *Professor of Education*  
 Skinner, Leroy C., M.A., *Associate Professor of Physical Education*  
 Smith, Grover, Ph.D., *Professor of English*  
 Smith, Peter, Ph.D., *Professor of Chemistry*  
 Spragens, Thomas, Ph.D., *Assistant Professor of Political Science*  
 Steegar, David M., M.A., *Instructor in Romance Languages*  
 Strandberg, Victor H., Ph.D., *Associate Professor of English*  
 Sullivan, James B. III, Ph.D., *Assistant Professor of Biochemistry*  
 Tiryakian, Edward A., Ph.D., *Professor of Sociology*  
 Trivedi, Koshor, Ph.D., *Assistant Professor of Classical Studies*



Wachtel, Howard, Ph.D., *Associate Professor of Biomedical Engineering and Assistant Professor of Physiology*

Ward, Calvin L., Ph.D., *Associate Professor of Zoology*

Weintraub, E. Roy, Ph.D., *Associate Professor of Economics*

Weitz, Henry, Ed.D., *Professor of Education*

Welsh, Paul, Ph.D., *Professor of Philosophy*

Whatley, Judith, Ph.D., *Lecturer in Psychology*

Wheeler, Alfred P., *Temporary Part-time Instructor in Zoology*

White, Fred M., M.F., *Assistant Professor of Silviculture*

White, Eleanor, M.S., *Assistant Professor of Nursing*

White, Richard Alan, Ph.D., *Professor of Botany*

Wilbur, Robert L., Ph.D., *Professor of Botany*

Wilder, Pelham, Ph.D., *Professor of Chemistry*

Williams, George W., Ph.D., *Professor of English*

Wilson, John, D.Phil., *Associate Professor of Sociology*

Woods, Nancy F., M.S.N., *Assistant Professor of Nursing*

Wolbarsht, Myron L., Ph.D., *Adjunct Professor of Physiology and Biomedical Engineering*

Woolford, Ellen, M.A., *Instructor in Anthropology*

Wyse, Allen M., Ph.D., *Assistant Professor of Economics*

Yohe, William P., Ph.D., *Professor of Economics*

Young, Charles R., Ph.D., *Professor of History*



## General Information



## The Summer Program at Duke

The summer session at Duke University makes available to Duke students, to students from other universities and colleges, to teachers in elementary and secondary schools, and to other special students a notable program of instruction in many fields of knowledge, both academic and professional. Course programs offered during the summer are designed to meet special and particular needs as well as the more conventional requirements leading to specific degrees.

Postdoctoral research scholars may find the regular summer session courses useful for further study. The library facilities and the various laboratories may be valuable for postdoctoral residents. Graduate students who have been admitted to the Graduate School to study for the Master of Arts, Master of Education, and Master of Arts in Teaching degrees will find courses arranged in sequence from summer to summer to meet their requirements. Teachers from elementary and secondary schools who desire to earn credits toward the renewal of their certificates and who are interested in further teacher training in subject content and method may enroll in senior-graduate courses as special or unclassified students. Undergraduates of Duke University who desire to accelerate their programs may complete the work for a degree in three years by attending two or more summer sessions. Undergraduates from other colleges and universities may enjoy the special advantages of summer instruction at Duke and transfer credits earned to their own institutions.

Although the summer course program meets, in many departments, the needs of degree candidates, it goes beyond these limits in also presenting courses of wide general interest and, in addition, special non-credit lectures, conferences, institutes, and workshops. Duke University's ample and modern research facilities will be available during the summer to all properly qualified students. It is the hope of the University, of the summer faculty, and of the administrative officers that former students and new students will find increasing value in each summer spent at Duke.



## Program Information





## Undergraduate Study

Students in the undergraduate college and schools of Duke University who desire to enrich or accelerate their academic study will find summer programs to meet their individual needs and interests. Special courses are provided which are not otherwise available to undergraduates; election of the usual courses may relieve an overload during the fall or spring terms. Summer programs also enable some students to attain provisional graduate status in the senior year or to graduate in less than four years.

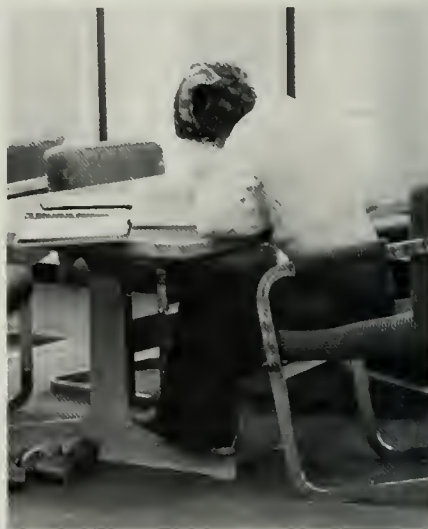
By attending at least two terms of the summer session, it is possible for a student to earn credit for as many as four semester-courses. Instruction will be offered in the summer of 1976 in most departments and colleges. Specific requirements for degrees offered in the undergraduate colleges and schools may be obtained from the *Bulletin of Undergraduate Instruction*.

## Divinity School Studies

The degrees of Master of Divinity and Master of Religious Education are administered by the faculty of the Divinity School. Students in these programs may register with the Summer Session Office for independent study in any one of the terms of the summer session or for the language courses which are listed under the heading of Divinity School in this *Bulletin*. Persons desiring credit toward one of these degrees must be admitted to the Divinity School, and all courses taken by the student for Divinity School credit must be registered and approved by the Director of Academic Affairs of the Divinity School.

## Graduate Study

**Degrees and Requirements.** The Graduate School of Duke University now offers the following degrees: Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Health Administration (M.H.A.), Doctor of Education (Ed.D.), and Doctor of Philosophy (Ph.D.). The Master of Business Administration degree (M.B.A.) is offered by the Graduate School of Business Administration. Specific requirements relative to admission, residence, major and related studies, languages, and thesis requirements may be obtained from the *Bulletin of the Graduate School*.



Candidates for degrees in the Graduate School desiring to have their degree conferred on September 1 must have completed all requirements for the degree as of the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree officially conferred at the following May graduation exercises.

**Unclassified Graduate Students.** Any student who holds an A.B. or B.S. degree and who does not intend to earn an advanced degree at Duke University but who desires graduate work for professional or other reasons should apply to the Director of the Summer Session for admission as an unclassified student. Credits earned by an unclassified graduate student in graduate courses taken at Duke before his admission to the Graduate School may be carried over into a graduate degree program if (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

**Cooperative Program in Teacher Education.** Selected graduates of liberal arts colleges who desire to prepare for high school teaching will be admitted to a special internship program at Duke University. This program is designed for selected college graduates who did not prepare professionally for teacher certification as undergraduates. The cooperative program provides for selected candidates graduate study in their special fields, professional courses, and carefully supervised observation and teaching experiences. One who completes the program successfully can achieve, within a period of fifteen months, a year of teaching experience, a Master of Arts in Teaching degree, and full certification as a teacher.

Candidates will begin the program at the opening of Term II of the 1976 summer session and complete it in August, 1977. They will spend two terms of the summer preceding and the summer following the year of teaching in residence at the University. During the school year 1976-1977 interns will be employed as regular teachers in cooperating public and private school systems. During this year they will receive full salary and will work under the joint supervision of the cooperating school and the University. The program will meet training qualifications for the advanced or graduate teacher's certificate in many states. Participants in the program are encouraged to teach for a second year as fully certified teachers in the school in which they complete the internship.

The salary for the year of teaching will, in effect, constitute a substantial award to candidates selected for the program. Interns will benefit from Duke University's special tuition rate for teachers. Applicants will be considered, as are candidates for other awards, on a competitive basis. The best qualified applicants will be chosen on the basis of undergraduate record, recommendations, and evidence of interest in becoming high school teachers. It is suggested that applicants arrange interviews in connection with their applications. Application forms and details concerning the program can be obtained by writing the Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Duke University. Application forms should be submitted before February 1, 1976.

## **Postdoctoral Research**

Scholars engaged in postdoctoral research find it advantageous and sometimes essential to use the resources of the Duke University libraries during the summer. The University welcomes these visitors and makes living accommodations (dormitory space and dining facilities) available to them during the summer sessions from May 11 to August 20, 1976.

### **Policy of Nondiscrimination**

Duke University does not discriminate on the basis of race, color, national and ethnic origin, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other university program or activity. It admits qualified students of any race, color, sex, national and ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.





## Special and Cooperative Programs





## Cooperative Program

The long standing reciprocal agreement between Duke and the University of North Carolina is now effective for the summer sessions at both universities. To take advantage of this arrangement for either term of the summer session, the student registers each term for 3 units of credit at the home institution and 3 units representing the course to be taken at the other institution, for a total of 6 units. Credit so earned is not defined as transfer credit. This program applies to both graduate and undergraduate students.

## Special Conferences and Courses

**Special Programs for Teachers of Science and Mathematics.** It is anticipated that the summer session will offer a number of special programs at the graduate level designed specifically for high school teachers of science and mathematics. For detailed information on the programs, teachers should write Dr. Sherwood Githens, Department of Education, Duke University, Durham, North Carolina 27708.

**Highlands Biological Station.** Duke University holds a subscribing instructional membership in the Highlands Biological Station at Highlands, N. C., on the southern edge of the Blue Ridge Mountains at an elevation of 4,118 feet. The situation and the region offer an excellent opportunity for field studies and some laboratory work. A limited number of qualified students in botany and zoology may make arrangements to carry out research at this station.

**Medical Mycology.** A comprehensive course in medical mycology is offered during the month of July at the Duke University Medical Center. The class will meet daily Monday through Friday, beginning on July 6 and ending July 30, 1976.

The laboratory will be a major part of the course, and it will concentrate on the practical identification of both saprophytic and pathogenic fungi. Students will participate in all aspects of diagnostic mycology for the collection of patient specimens and identification of organisms, through fungal serology and record-keeping. The lecture material will survey the mycology, immunology, pathogenesis, and epidemiology of all the pathogenic fungi. Several internationally recognized mycologists will be invited as guest lecturers to meet with students and discuss their particular areas of expertise and current research interests.

The enrollment for the course will be limited to twenty students, and applications will be considered in the order received. A fee of \$200 will be charged for this course; alternatively, a student may register in the summer session, pay the tuition required, and receive 4 units of graduate credit for the course. All inquiries should be addressed to Dr. Thomas G. Mitchell, Department of Microbiology and Immunology, Duke University Medical Center, Durham, N. C. 27710.

**The Ministerial Course of Study School.** In cooperation with the Board of Education and the Southeastern Jurisdictional Conference of the United Methodist Church, Professor Paul A. Mickey directs the Ministerial Course of Study School. This is not related to the regular Divinity School degree program, and no credit toward a seminary degree can be earned. The twenty-eighth session of the school is from June 28 to July 23. For further information write the Director, Box 4484, Duke Station, Durham, N. C. 27706.

**Divinity School Summer Institute for Ministry.** Seminars and clinics, running concurrently, for ministers, wives, and church leaders of all denominations will be conducted at the Duke Divinity School, June 28-July 2 and July 5-9, 1976. These are designed to supplement seminary education through one or two weeks of intensive training in academic and professional studies. No academic credit is given.

Sponsoring institutions make funds available for tuition. Other scholarships are available upon request. For full information write the Director of Continuing Education, Duke Divinity School, Durham, N. C. 27706.



**Summer Drama Program.** The Duke University Drama Program offers theater-oriented students and teachers an integral program of training in theater and dramatic literature during the first and second summer sessions.

The courses in practical theater, taught by members of the professional staff of Summer Theater at Duke, will offer formal instruction and supervision in all aspects of theatrical production. In addition, a group of related courses in dramatic literature will offer the student a close study of the great plays of the past and present. Teachers and future teachers will be particularly interested in the new course in educational theater.

Please look under the course listings in Drama for further information. Detailed information on faculty, courses, productions, and auditions for Summer Theater at Duke may be obtained by writing Box 4941, Duke Station, Durham, N. C. 27706.

**Southeastern Institute of Medieval and Renaissance Studies.** Participation in the Southeastern Institute of Medieval and Renaissance Studies is open to those with scholarly interest in all areas of medieval and Renaissance studies, including (among others) art, aesthetics, history, literature, music, paleography, philosophy, and religion. The institute consists of six informal seminars, each concerned with a topic of interest to students of the medieval and Renaissance periods. Each seminar is led by a senior fellow and has an enrollment of about six participants, designated fellows. Each fellow participates in one seminar and has ample time to devote to his own research. It is emphasized that the seminars are not courses but informal meetings to encourage the exchange of ideas and to stimulate participants in their own research. In most cases fellows will be beyond the Ph.D. level, but in some cases applications will be considered from advanced graduate students.

The public is invited to attend a series of lectures on medieval and Renaissance topics during each session of the institute.

Annually the institute alternates between the campuses of Duke University and the University of North Carolina at Chapel Hill. The eighth session, from June 28 to August 6, 1976, will be held on the Duke campus.

**Summer Dance.** Summer Dance is sponsored by the Summer Arts Institute, Inc. in association with Duke University. Summer Dance offers instruction in a variety of dance disciplines (modern—technique, theory, and production—ballet, tap, jazz, ballroom, and movement in theatre among others) with an emphasis on modern dance. A modern dance company will be in residence to teach and perform for several weeks during the summer. For more information, write Summer Dance, Box 6966, College Station, Duke University, Durham, N. C. 27708.



**Resources for Study**





## Libraries

The William R. Perkins Library consists of the new research library building which was opened early in 1969 and the old building which was renovated in 1970. The complex has about 2,100 seats (700 of which are private carrels) and shelf space for 2,500,000 volumes.

On June 30, 1975, the University libraries, including nine school and six departmental collections, contained 2,622,167 volumes and 4,529,000 manuscripts. One hundred thousand volumes are added each year and about 15,000 periodicals are received regularly. Many rare and perishable materials which appeared in books, newspapers, periodicals, and manuscripts are available in microtext form and may be read in a special microtext reading room in the Perkins Library. Rare books and manuscripts have special quarters in the building, which are accessible to all members of the University community.

All libraries of the University are open for use throughout the summer. Guides to the Perkins Library for faculty and graduate and undergraduate students are available upon request to the University Librarian, Perkins Library, Duke University, Durham, N. C. 27706.

## Laboratories

The laboratories in the various science departments (botany, chemistry, physics, psychology, and zoology) are designed for both teaching and research. Ideal locations for special work in some of the sciences are available at Duke University Marine Laboratory at Beaufort, North Carolina; at Highlands Biological Laboratory at Highlands, North Carolina; in the Duke Forest at Durham, North Carolina; and in the Sarah P. Duke Gardens on the West Campus of Duke University.



**Student Life**



## Living Accommodations

Duke University provides residence hall accommodations on West Campus for graduate and undergraduate students enrolled in the summer session. Efforts are made to house all students in air-conditioned facilities, but because these are limited, use of non-air-conditioned facilities may become necessary.

Air-conditioned apartments are available for single students and married students accompanied by their families. Units in the new Central Campus Apartments and Town House Apartments will be used.

Information for each type of residential accommodation may be obtained by writing the appropriate manager whose address is found on page 22 in the chapter on Financial Information.

**Dining Service.** Food service is cafeteria style. The cost of meals depends on the needs and tastes of the individual. Only the dining facilities on the West Campus will be used for the regular summer session students. The cafeteria in the Men's Graduate Center is usually not open in the summer.

**Duke University Marine Laboratory.** The Duke University Marine Laboratory, located on Pivers Island, has cottage-type residence halls which will be available for summer session students. Further information may be obtained from the *Bulletin of the Duke University Marine Laboratory*.

## Services Available

**Medical Care.** The Student Health Service, located in the Marshall I. Pickens Rehabilitation Center, operates during the summer session and, except for hospitalization in the University infirmary, offers the same medical and surgical services available to full-time students during the academic year as described in the *Bulletin of Information and Regulations*. Use of the Student Health Service is restricted to matriculating students. Presentation of a current student identification/enrollment card is required.

The University Health Program is currently being evaluated in terms of costs and coverage; therefore, beginning with the 1976-77 academic year a separate fee for this service may have to be assessed.

The Student Mental Health Service is located in the Pickens Rehabilitation Building on Erwin Road. The service provides evaluation, brief counseling, and



treatment for matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Student Mental Health Service records are maintained separately and are not a part of any other record system, academic or medical. Contact with the service is strictly confidential. No illness is treated in dormitories or other student residence rooms.

Regular clinic services are available for use from 8 a.m. to 6 p.m. Monday through Saturday and from 2 p.m. to 8 p.m. Sunday at the University Health Clinic, Pickens Building, West Campus, Phone 684-6721.

**The University Counseling Center.** The University maintains a University Counseling Center which provides a centralized program of educational, vocational, and personal counseling for students. This confidential counseling service on problems of personal, social, educational, and vocational adjustment is provided without cost to students enrolled at the University. In addition, the center administers special group testing programs for University schools and departments and serves as the local testing center for a wide variety of national testing programs. The center also carries on programs of research in the field of measurement and counseling. Although the counseling, testing, and research services of the center are designed primarily to meet the needs of the students, faculty, and staff of Duke University, these services are made available to individuals and organizations outside the University as its facilities permit. Requests for further information should be addressed to the Director, University Counseling Center, 309 Flowers, Duke University, Durham, North Carolina 27706.

**Office of Placement Services.** Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business, education, and government. All services are offered without charge to students in the summer session who are registered for a degree at Duke University. The staff is available to talk with summer session students about their professional plans and with school officials who may be seeking the services of new teachers. Students who are eligible to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions and to have a permanent file for future reference. Pertinent recommendations should be accumulated during the time the student is enrolled at Duke.

Part-time employment listings for the campus and Durham area are maintained in the office. All students interested in working during the summer session should register at the beginning of the term. Every effort will be made to help each student find a job consistent with his interests.

## Student Activities

**Religious Life.** During the summer the Duke Chapel is open every day for prayer and meditation from 9:00 a.m. to 8:00 p.m. The Sunday morning worship in the Chapel at 11:00 a.m. is the central focus for the summer ministry. The University ministers and chaplains are available for assisting in planning programs and projects and for discussions and personal counseling.

**Recreation and Activities.** The summer session will provide a varied program of entertainment and recreation. The program includes movies, dances, and open house socials. Tours to areas of interest can be arranged for weekends. Both the mountains and the seashore are easily accessible. Adequate facilities are available for those interested in swimming, tennis, and other sports. Clubs organized for the summer play an active part in all social activities and recreation.

**Summer Theater at Duke.** For its fifth season, the Summer Theater at Duke





will offer four major productions and four "Midnight Specials" during a season which will run from May 28 to July 19. There will be a discount on admission prices for Duke students. Production schedules and season ticket information may be obtained at Page Box Office.

Interested students are invited to join the company or crew of Summer Theater at Duke. For further information on productions and auditions, write to Professor John Clum, Box 4941, Duke Station, Durham, N. C. 27706.

## **Publications**

During the summer the University will publish each session *The Duke University Calendar*, an official calendar announcing events—academic, social, and recreational—of the following term. This calendar also includes official notices concerning academic requirements. Students are expected, therefore, to read the *Calendar* regularly.

## **Conduct of Students**

Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University currently in effect or which are, from time to time, put into effect by the appropriate authorities of the University. The student is expected to be familiar with the current *Bulletin of Information and Regulations* as well as any published regulations for the summer session.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University. University authorities will take action in accordance with academic due process.



Admission





## Qualifications for Admission

Students in the following categories may be admitted to the Duke University Summer Session:

1. Graduates and undergraduates who are presently enrolled and in good standing in Duke University.
2. Graduates and undergraduates who have been formally admitted or re-admitted to Duke University.
3. Students who are currently in good standing at their respective institutions and who have approval by the proper authority to take and transfer credits earned in the Duke Summer Session.
4. Teachers in service with or without the bachelor's degree who wish to earn credits for certification purposes.

Admission to specific courses offered in the summer session is governed by the student's academic status (freshman, sophomore, junior, senior, graduate, special, or unclassified) and by the prerequisites of the course in question. All applicants are considered without regard to race, color, religion, sex, or national origin.

## Application Procedures

**Duke Students in Residence during the Spring Semester, 1976.** A Duke University student, either graduate or undergraduate, who plans to attend the summer session should at the time of preregistration for the fall semester (see page 66 for specific dates) enroll for the desired summer session courses. He need not file with the Summer Session Office the application blank at the end of this *Bulletin*.

**Undergraduates Not in Residence at Duke during the Spring Semester, 1976.** New students seeking to enter Duke University as freshmen or as undergraduates with advanced standing, and undergraduates who wish to reenter the University, should write the Office of Admissions requesting application forms.

Undergraduates, both men and women, enrolled in other colleges and universities who desire to earn in the Duke University Summer Session credits which are to be transferred to their own institutions should apply directly to the Director of the Summer Session, Duke University, on the application form at the end of this *Bulletin*. They should give accurately and clearly all information called for on the application form.

**Graduates Not in Residence at Duke during the Spring Semester, 1976.** Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School must also file Graduate School application





forms which may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

Students who have graduate standing, who are currently employed as teachers, and who wish to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 3 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application at the end of this *Bulletin* may be used.

**Postdoctoral Scholars.** Application for postdoctoral research privileges must be made in advance by letter to the Director of the Summer Session giving the applicant's present position, the specific field of his research interest, and the dates during which he desires to be in residence. Approved applicants will be accepted subject to the availability of library and dormitory space.

## Admission to Degree Candidacy

**Undergraduates.** A student seeking to enroll as a candidate for the bachelor's degree from a college or school of Duke University must meet the entrance requirements set forth in the *Bulletin of Undergraduate Instruction* and be accepted by the Director of Admissions, Duke University. This *Bulletin* may be secured by writing the Office of Admissions, Duke University, Durham, N. C. 27706.

**Graduates.** A student seeking to enroll as a candidate for one of the advanced degrees offered by the Graduate School of Duke University must meet the requirements set forth in the *Bulletin of the Graduate School*. This *Bulletin* may be secured by writing to the Office of the Graduate School, Duke University, Durham, N. C. 27706.



## Financial Information



## Tuition and Fees

**The University Tuition.** The following charges will cover registration and medical care:

1. Tuition for undergraduates—\$258 for each non-laboratory course, \$344 for each undergraduate laboratory course, and \$516 for each one and one-half course program offered at the Marine Laboratory.
2. Tuition for graduate students—\$86 per unit; for an undergraduate course, the tuition rate is as indicated in paragraph one above.
3. Teachers in full-time service in elementary and secondary schools, except teachers pursuing a doctoral program at Duke—one-half of the tuition charges specified in paragraph one and two above.
4. All students pursuing a doctoral program at Duke (post-master's)—fees as specified in paragraphs one and two above.

**Laboratory Fees.** For Marine Laboratory investigators' research table fee, see the *Marine Laboratory Bulletin*.

**Medical Mycology Fee.** This fee of \$200 replaces the University tuition.

**Master's Degree Summer Session Tuition.** A master's candidate who submits his thesis when not registered for at least 1 unit of research-residence tuition is required to pay the 1-unit tuition of \$86.

**Auditing Fees.** These fees are as follows:

1. Students registered for a full course program may audit non-laboratory courses (with the permission of the Director) at no extra charge.
2. Students carrying less than a full course program may be granted permission to audit a course but they will pay half the University fee for the course.

**Late Registration Fee.** Students who fail to register prior to the first class day of a given course will pay an extra charge of \$25.

**Fee for Course Changes.** Course changes other than those required by the University will be made only on payment of an extra fee of \$1 per change.

**Fee for Make-up Final Examination.** This fee is \$5.

**Refund for Tuition and Fees.** Tuition and fees will be refunded under the following circumstances:

1. When applications for withdrawal are received by the Director of the Summer Session before the first class day of a given term of the summer session, full tuition and fees will be refunded.



2. When applications for withdrawal are received by the Director of the Summer Session during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the Director of the Summer Session after the fourth class day, there will be no refund of tuition and fees.

**Debts.** No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

## Living Accommodations

### Rates for Residence Hall Space for Each Summer Term\*

	<i>All courses except Science and Medical Mycology</i>	<i>Science and Medical Mycology</i>
Single occupancy	\$135	\$116
Double occupancy	\$100	\$ 86

\*Rates for non-air-conditioned space when used will be somewhat lower.

Rates for one, two, or three-bedroom apartments vary according to the type unit desired and the number of persons occupying the apartment. Linen rental service is available through the Student Laundry on West Campus. No housewares are available for use in apartments.

For detailed information on types of accommodations available at Duke University for the summer session write: (for residence halls), Manager of Residence Halls, Department of Housing Management, Duke University, Durham, N. C. 27706; (for apartments), Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, N. C. 27706.

## Estimated Cost of One Term of the Summer Session

University tuition, two non-laboratory courses or 6 graduate units	\$516.00*
Residence Hall Fees (double room for one term)	100.00
Books and class materials (average)	20.00†
Miscellaneous (laundry, etc.)	20.00†
	Total \$656.00

Meals are cafeteria style; costs will vary according to individual tastes and needs.

\*Teachers, elementary and secondary, in full-time service (except teachers pursuing a doctoral program at Duke) pay \$258.

†Approximate costs will vary according to individual needs.

## Student Aid

**Special Tuition Rate to Teachers.** Teachers in full-time service in elementary and secondary schools, except those who are pursuing a doctoral program at Duke, pay only one-half of the regular tuition charge. Teachers on leave of absence from their schools and teachers not currently employed are not eligible for this special fee.

**Scholarships for Public School Personnel.** Duke University will offer twenty special scholarships of \$258 each to high school and elementary teachers, supervisors, and administrators on a competitive basis (not by a written examination) for the summer session of 1976. This scholarship program is intended to encourage teachers, supervisors, and administrators to begin or continue their graduate studies leading to advanced degrees.



Although successful applicants for the scholarships will not be required to become candidates for a degree, they must qualify for, and receive admission to, the Graduate School.

All applications with supporting documents must be submitted by April 1, 1976. Selection and appointment of scholars will be completed by May 1, 1976.

Application blanks and complete information may be obtained from Dr. Paul D. Williams, Jr., Assistant Director of the Summer Session, 116 Allen Building, Duke University, Durham, N. C. 27706.

**Loans.** A number of loan funds have been established for the benefit of students of Duke University. Several of these funds are available to students enrolled in the summer session. Students enrolled in the summer session *only* are not eligible. These funds are administered through the Financial Aid Office and the Student Loan Office.

Financial need is the major determinant in reviewing applications for student loans.

Applicants for loans should make application to the Financial Aid Office, Duke University. All applications must be initiated during the first week of each term. The granting or withholding of a loan is a matter entirely within the discretion of the Financial Aid Office and the Student Loan Office. A student is expected to use all other possible means of securing financial assistance before applying for aid from a loan fund.

*National Direct Student Loan Program.* A limited number of loans may be made, under the provisions of the Education Amendments of 1972, to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session *only* is not eligible for consideration. Students pursuing the M.A.T. Co-operative Program are not eligible. Inquiries concerning opportunities available under this program should be made to the Director, Student Loan Office, Duke University, Durham, N. C. 27706.

*Duke University Federally Insured Loan Program.* Under this program, students are allowed to borrow up to \$2,500 per year at a 7 percent interest rate. An interest subsidy is available from federal funds for all students who have demonstrated need on the Parents' Confidential Statement. As under the National Direct Student Loan Program, loans can be made to students in the summer session who have been regularly enrolled in the University prior to the summer session. A student who is enrolled for study in the summer session *only* is not eligible for consideration. Inquiries concerning opportunities available under this program should be made to the Financial Aid Office of the school to which the student is applying for admission or the school in which he is enrolled.

**Remission of Tuition.** Children of Methodist ministers who are members of the North Carolina and Western North Carolina Conferences of the United Methodist Church are entitled to a partial remission of the tuition charge. This consideration is given only to the children of resident members of the two North Carolina conferences who are giving their full time to religious work. Only those students enrolled in a regular undergraduate program leading to a baccalaureate degree from the University are entitled to this benefit. Students in this group are entitled to a maximum of eight semesters of eligibility at the undergraduate level. Application for this benefit should be made to the Director of Undergraduate Financial Aid, Duke University, Durham, N. C. 27706.

**Tuition Grants.** Tuition grants are available to children of faculty and qualified staff members of Duke University. Information regarding the tuition grant program may be obtained by writing to the Director of Undergraduate Financial Aid, Duke University.



## Registration and Regulations



## Definition of Terms

**Registration.** A student has completed registration for the summer session when:

1. His course program has been written and approved by the dean of the school or college in which he is enrolled or by the Director of the Summer Session in the case of the special or unclassified student.
2. Summer session forms have been completed properly by the student in the Summer Session Office, 116 Allen Building.
3. University fees for the summer session have been paid; a place in a course cannot be assured until this has been done. Tuition bills are not sent to the student's home.

**Pre-Enrollment.** The term *pre-enrollment* refers only to the writing of the course program and its approval by the proper authority or by the Director of the Summer Session in the case of the special or unclassified student. Pre-enrollment alone does not constitute registration.

## General Registration

In the 1976 summer session, classes in Term I will begin on Tuesday, May 11; in Term II on Monday, June 14; and in Term III on Monday, July 19. A student attending Term I, Term II, or Term III of the 1976 summer session must complete his registration in the Summer Session Office, 116 Allen Building, on or before the Friday preceding the first class day of the given term (Term I, Friday, May 7; Term II, Friday, June 11; Term III, Friday, July 16).

A student in classes beginning on dates other than the beginning date of each of the three terms must complete his registration in the Summer Session Office before the date on which those classes begin.

## Late Registration

Any student who fails to register on or before the dates specified in the preceding paragraphs will be charged a fee of \$25 for late registration. All late registrations and course changes must be completed by the end of the third class day of each term (May 13, Term I; June 16, Term II; and July 21, Term III). All course changes must be approved by the dean of the school or college in which the



student is enrolled, or, in the case of the special or unclassified student, by the Director of the Summer Session.

Since summer session courses present a program of study in more concentrated and rapid form than in the regular semesters, students are advised to register on time and to be present at all class sessions.

## Advanced Registration

**Students in Residence during the Spring Semester, 1976.** Graduate and undergraduate students in residence at Duke University during the spring semester, 1976, who plan to enroll for courses or research in one or more terms of the 1976 summer session will write course programs and have them approved in their respective schools or college during the week of preregistration, March 29-April 1, 1976.

Graduate and undergraduate students in residence, whose course programs have been written and approved by their respective schools or college on the date indicated above, may complete their registration in the Summer Session Office, 116 Allen Building, by paying their tuition from May 1 to May 7, 1976.

A Duke student, graduate or undergraduate, who desires to attend the summer session but did not preregister from March 29 to April 1, 1976, should complete his registration by the Friday preceding the beginning of the term he wishes to attend.

**Students Not in Residence at Duke during the Spring Semester, 1976.** Students not in residence at Duke University during the spring semester, 1976—new undergraduate students seeking to enter as degree candidates, graduate students who are not candidates for an advanced degree at Duke University, graduate and undergraduate students of other colleges and universities desiring to earn credits for transfer, public school teachers, and college teachers (not advance degree candidates)—may register by mail. Advance registration by mail includes:

1. Completion in full of the application form at the end of this *Bulletin*.
2. Admission to the summer session by the Director of the Summer Session and, in case of a student seeking to enter Duke University as a degree candidate, admission by the admissions director to the school or college of Duke University concerned.
3. Completion in full and return of forms required by the Summer Session Office at least one week prior to the beginning of the term involved.
4. Payment of tuition by at least one week prior to the beginning of classes.

Students who have not completed their registration by mail for courses in Terms I, II, and III should complete their registration in the Summer Session Office, 116 Allen Building, by the Friday previous to the first class day of Terms I, II, and III.

**Degree-Candidate Graduate Students Not in Residence during the Spring Semester, 1976.** A graduate student not in residence during the spring semester, 1976, who is a candidate for an advanced degree in the Graduate School of Duke University, may complete his registration by mail if his director of graduate studies and the Graduate School Office approve the registration. The student will follow the same four steps given above. Any graduate student unable to complete registration by mail must present himself for registration in the Summer Session Office on May 7 for Term I, June 11 for Term II, and July 16 for Term III.

**Registration of Graduate Students.** Graduate students in residence during the spring semester will preregister for one or more terms of the summer session on March 29 through April 1. Newly admitted graduate students who have not





completed their registration by mail should present themselves for registration at the official registration periods. All graduate students are required to register both with the Summer Session Office and with the Graduate School Office.

Graduate students resident in the spring semester who intend to remain in residence during one or more of the three summer session terms without registering for course work or at least 1 unit of research must register for 1 unit to cover the cost of medical care and the use of University facilities. These units of registration will entitle students to use the Student Health Service and University facilities during the three terms of the summer session. The master's candidate who has completed all requirements except submission of the thesis and who so registers is not charged any separate fee for submitting the thesis, but he is required to register for 1 unit of research.

#### **Graduates Not in Residence at Duke during the Spring Semester, 1976.**

Students who are seeking admission to the Graduate School and those who have been admitted to the Graduate School must apply to the Director of the Summer Session on the application form at the end of this *Bulletin*. Those who are seeking admission to the Graduate School must also file Graduate School application forms which may be secured by writing to the Dean of the Graduate School, Duke University, Durham, North Carolina 27706.

Students with graduate standing and currently employed as teachers who wish only to earn credits toward renewal or the advancement of their certificate may enroll in the summer session as unclassified graduate students without becoming candidates for a degree at Duke University. Credits earned by unclassified graduate students in graduate courses at Duke may later be counted toward an advanced degree at Duke if the conditions stated on page 23 are met. All students in the unclassified category should apply to the Director of the Summer Session for admission. The application form at the end of this *Bulletin* may be used.

## Academic Regulations

**Types of Course Enrollment.** Summer session courses may be taken for credit or may be audited. A student's program may be exclusively in one of these categories, or a combination of the two. Students taking a full or partial program for credit may enroll as auditors in any number of additional courses.

The summer session term *credit* does not mean degree credit at Duke University unless the student has been admitted as a degree candidate by one of the colleges or schools of the University. A student taking a course for credit is expected to do all the work required and to take the final examination, and he will receive a grade. G.I. Bill benefits are available only to those veterans who enroll for credit.

An auditor is entitled to listen to lectures and class discussions, but he may not participate in discussions or take examinations. A student carrying a full program for credit may be given permission to audit as many courses as he desires without additional fees. Students carrying less than a full program for credit may secure permission to audit but are required to pay the auditing fee, which is half the regular fee.

**Credits.** The summer session courses are of the same quality and credit values as courses in the regular semester. Credit earned in the summer session is in terms of courses or units. The majority of summer session courses carry one course to 3 graduate units of credit and require one term in residence.



A student desiring either graduate or undergraduate credits transferred from Duke University to his university or college as degree credit must request from the Director of the Summer Session, Duke University, a Course Approval Form to be completed by the student's dean or registrar and returned to the Director of the Summer Session.

Under certain circumstances a maximum credit of 6 units in a master's degree program may be allowed for graduate courses completed elsewhere. Approval for the transfer of credits will not be given until the student has spent one semester or two terms in residence. The acceptance of credit up to this amount will not reduce the minimum period of full-time registered residence at Duke University. In no case will credit be allowed for extension or correspondence courses.

With the approval of both the student's major department and the Dean of the Graduate School, a student who is granted such transfer of credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. He may be permitted to fill out his schedule with as much as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level.

For regulations concerning the application of graduate credit earned elsewhere to a graduate program here, consult the *Bulletin of the Graduate School*. See page 7 for information concerning the Cooperative Program with the University of North Carolina (also including North Carolina State University and North Carolina Central University).

Professional credits toward teacher's certificates are granted by the various state boards of education, each in accordance with its own carefully planned rules. Teachers in service, before enrolling for certification credit, should consult the rules laid down by their state board of education. If necessary, they should send to their state board of education a list of the courses in which they plan to enroll and inquire whether these will be acceptable for certification credit.

**Maximum Course Program.** The maximum program for one term of the summer session is two courses.

**Dropping of Courses.** During the first three days of classes in any term, a student may add or drop a course with the permission of the instructor. Thereafter, no course may be added. A course may be dropped without penalty, however, until the end of the second week of each term with the permission of an academic dean. (The permission of the Director of the Summer Session is required for students from other universities or colleges.) Courses dropped after the second week are ordinarily assigned an *F* grade, as are courses dropped without permission.

**Grading.** Only a student taking a course for credit will receive a grade. The grade given represents the quality of the work done in the course.

*Passed.* The following are passing grades for undergraduates and graduates:

**Undergraduate Grades**

A—exceptional  
B—superior  
C—satisfactory  
D—low pass

**Graduate Grades**

E—exceptional  
G—good  
S—satisfactory

*Failed.* A grade of *F* indicates that the student has failed the course. In order to receive credit for the course he must repeat the work in class.

*Pass/Fail Option.* With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one



elective, non-major course each summer. In addition, with the consent of the instructor, adviser, and director of undergraduate studies a student may take for pass/fail credit courses in independent study or internship in any department including that of his major. Certain internships and small group experiences will be offered only on a pass/fail basis.

For the effect of the election of the pass/fail option in determining honors, consult the *Bulletin of Undergraduate Instruction*.

*Incomplete.* A grade of *I* may be reported by the instructor if for any reason he is unable to report the final grade at the regular time. Incomplete courses must be completed before the close of the succeeding semester; otherwise the *I* is recorded as *F*, and the course must be repeated in class if the student is to receive credit for it.

*Absent from Final Examination.* The grade of *X* indicates that the student was absent from the regularly scheduled examination. A student absent from examination, if the absence has been excused by the dean of the college or school in which he is enrolled or, in the case of the special of unclassified student, by the Director of the Summer Session, may receive an examination upon the payment of \$5 to the Bursar of the University. The instructor concerned arranges for the examination in cases where absences are excused. A student with an *X* grade





who has not obtained a passing grade before the end of the semester following that in which the X was incurred is regarded as having failed in the course concerned and must repeat the work in class in order to receive credit. If a student's absence from an examination is not excused by the dean of the college or school in which he is enrolled or, in the case of the special or unclassified student, by the Director of the Summer Session, his grade for the course concerned is recorded a F.

**Examinations.** Final examinations in courses are held on the last two days of each term. Final examinations for short courses will be held on the last day of the course. The examination dates for the First Term are June 11, 12; Second Term, July 15, 16; and Third Term, August 19, 20.

Courses in science for the first term have been scheduled so that their final examination will come on June 12. The science courses which begin on June 14 and run for four weeks will have their final examination on July 9. The University has no provision for giving examinations *in absentia*. Students absent from examinations for valid reasons are permitted a liberal extension of time to return to the University for the completion of credit.

**Continuation Requirements.** A student must achieve a satisfactory record of performance during the summer session in order to maintain his enrollment at Duke. Students regularly enrolled in Trinity College of Arts and Sciences who fail more than one course in a summer term or in a summer session will be excluded from the College. Where continuation from the summer session into the fall semester is in question, incomplete work in any course is considered failure to achieve a satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for the fall semester. No student who has incomplete course work from both the spring semester and the summer session may continue into the fall semester.

A student from another university or college may be dismissed by the Director of the Summer Session for failure to exhibit satisfactory performance.

**Withdrawal from the Summer Session.** If a student wishes to withdraw from the summer session, he must notify both the dean of the school or college in which he is registered and the Director of the Summer Session.

## Motor Vehicle Regulation

Students enrolled in the summer session must register their motor vehicles with the Traffic Control Office, 2010 Campus Drive, West Campus.

To register a vehicle, the student must present the following documents: (1) state vehicle registration certificate, (2) valid driver's license. A small parking fee will be charged.

Parking, traffic, and safety regulations will be given each student who registers his vehicle. Students are expected to abide by these regulations.



## Courses of Instruction



## Course Enrollment

**Eligibility.** Courses numbered 1-49 are primarily for freshmen, or freshmen and sophomores. Courses numbered 50-99 are ordinarily for sophomores, or sophomores and juniors. Courses numbered 100-199 are designed for juniors and seniors. Courses numbered 200-299 are planned for seniors and graduates. Courses numbered 300 up admit graduate students only. Courses numbered from 200 up are limited in enrollment to 25 students.

**Minimum Enrollment Required.** All courses are offered subject to minimum enrollments. The University reserves the right to withdraw undergraduate courses in which fewer than twelve students enroll, senior-graduate courses numbered 200-299 in which fewer than ten students enroll, and graduate courses are seminars numbered 300 or above in which fewer than six students enroll. In withdrawing a course, the University attempts to avoid undue hardships on students. Sometimes, therefore, courses are offered in spite of small enrollments. Courses not listed will be given when a demand develops and an instructor is available.

## Departmental Officials and Regulations

Departments offering summer session programs are listed alphabetically. Under each department is given the name of the chairman, the director of graduate studies, and the director of undergraduate studies. Where departments have set up special regulations for admission to candidacy for the master's degree, these are included.

## Summer Session Schedule of Classes

Summer session classes will meet Monday through Friday each week. Saturdays during each term are available for conferences or special class work.

Class Periods are as follows:

First Period: 8:00 a.m. to 9:20 a.m.

Second Period: 9:40 a.m. to 11:00 a.m.

Third Period: 11:20 a.m. to 12:40 p.m.

Fourth Period: 1:20 p.m. to 2:40 p.m.

The meeting place for a course is indicated immediately after the class period for the course. Building designations are as follows:

#### East Campus

A—West Duke  
B—Carr  
C—Science

E—Biddle Music Building  
F—Bivins

#### West Campus

3—Gray  
4—Perkins Library  
5—Foreign Languages  
9—Psychology-Sociology  
10—Social Sciences  
47—Engineering

49—Physics  
53—Allen  
58—Biological Sciences  
65—Gross Chemistry  
CG—Card Gym

Consult the Map of Duke University located in the back of this *Bulletin* for building locations.

## Anatomy

Professor Robertson, *Chairman* (465 Sands Building, West Campus); Assistant Professor Adelman, *Director of Graduate Studies* (270 Sands Building, West Campus)

### First Term

**151. Anatomy of the Lower Extremities as it Relates to Locomotion.** Dissection of the human adult lower extremity. Demonstration and discussion of gait, biomechanics, and kinesiology. One course. *Bassett*. 9:40-11:00. Bell 013

**312. Research.** Individual investigations in various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff*.

**340. Tutorial in Advanced Anatomy.** (Consult *Graduate School Bulletin* for description.) *Staff*.

**354. Research Techniques in Anatomy.** (Consult *Graduate School Bulletin* for description.) *Staff*.

### Second Term

**208. Anatomy of the Trunk.** Designed for Ph.D. degree candidates in anatomy as well as practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisites: core course in anatomy and permission of instructor. Number of students arranged by staff. 2 units. *Dule*.

**312. Research.** Individual investigations in the various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff*.

### Third Term

**312. Research.** Individual investigations in the various fields of anatomy. (Consult *Graduate School Bulletin* for description.) Credits to be arranged. Permission of staff required. *Staff*.



# Anthropology

Professor Friedl, *Chairman and Director of Graduate Studies* (03 AROD); Associate Professor Apte, *Director of Undergraduate Studies* (105 AROD).

## First Term

**94. Elements of Cultural Anthropology.** The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. Primarily meant for students not majoring in the social sciences. One course. *Apte*. 8:00-9:20. AROD 109.

**119. Language, Culture, and Society.** Analysis of language behavior within and across societies relating variations in linguistic usage to sociocultural factors: ethnosemantics, social dialects, ethnography of speech. Prerequisite: Anthropology 107 or permission of the instructor. One course. *Casson*. 11:20-12:40. AROD 109.

## Second Term

**93. Human Origins.** Origins and distribution of mankind; primate evolution; a survey of human paleontology and human biology, prehistory, and language; and the origins of human social organization and culture. One course. *Beecher*. 9:40-11:00. AROD 109.

## Third Term

**93. Human Origins.** (For course description see listing under second term.) One course. *Eaglen*. 9:40-11:00. AROD 109.

**94. Elements of Cultural Anthropology.** (For course description see listing under first term.) One course. *Woolford*. 11:20-12:40. Old AROD 109.

**107 Introduction to Linguistics.** Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. Prerequisite: sophomore standing. (Also listed as English 107.) One course. *Butters*. 8:00-9:20. 53.327.

**208S. Seminar in Selected Topics: Archaeological Field Methods.** Students will be trained in the methods of archaeological survey, excavation, data recording, mapping and analysis of artifacts through the excavation of a local archaeological site. A minimum number (10) of students is required for the course. The course will meet for six hours per day. Students will be responsible for providing their own transportation to and from the site. Once course. *Hammond*. TBA.

# Art

Professor Markman, *Acting Chairman* (112A East Duke Building); Assistant Professor Brown, *Director of Undergraduate Studies for Art History* (114A East Duke Building); Assistant Professor Pratt, *Director of Undergraduate Studies for Design* (101T West Duke Building, East Campus)

## First Term

**53. Drawing.** Directed approaches to practice in life drawing and in the expression of graphic concepts. Prerequisite: consent of instructor. (Enrollment limited to 18.) One course. *S. Pratt*. 10:00-12:40. A.106.

**54. Two-Dimensional Design.** Experiments in form and color, with work from observation. Introduction to color theory in painting and two-dimensional media. Prerequisite: Art 53 or consent of instructor. One course. *S. Pratt.* 1:20-4:00. A.106.

**146. Recent Interpretations of Contemporary Art.** The appraisal of critical issues in art history through the study and discussion of the visual arts and their criticism since World War II. Prerequisite: Art 66 or consent of instructor. One course. *Connolly.* 9:40-11:00. 10.232.

**153. Painting.** Studio practice in painting with individual and group criticism and discussion of important historic or contemporary ideas. Prerequisite: Art 54 or equivalent, and consent of instructor. One course. *V. Pratt.* 1:20-4:00. A.101.

**155. Advanced Drawing and Color.** Work from life or in formal modes, with emphasis on personal development through individual and group criticism and discussion. Prerequisite: Art 53 and 54, or consent of instructor. One course. *V. Pratt.* 10:00-12:40. B. 215.

**173. Advanced Painting.** Prerequisites: Art 153 and 154 and consent of instructor. One course. *V. Pratt.* 1:20-4:00. A.101T.

**Studio Fees.** A fee of \$40 will be charged to cover the cost of models and supplies for design courses only.

## Biochemistry

Professor Hill, *Chairman* (255 Medical Sciences I); Professor Rajagopalan, *Director of Graduate Studies* (235B Medical Sciences I)

### Third Term (Duke Marine Laboratory, Beaufort)

**276. Comparative and Evolutionary Biochemistry.** (Also Zoology 276.) Lectures and discussions of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. Two courses (6 graduate units). *Sullivan.*

## Biology\*

### Third Term

**14. Principles of Biology.** A one-semester introduction to the discipline open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. One course. *Staff.* 9:30-11:10, Monday through Friday. 58.130. 2:00-5:00, Monday through Wednesday. 58.115.

## Black Studies

Mr. Turner, *Acting Director* (110 Allen Building)

### First Term

**99. Dimension of Racism.** The nature of racism, its interconnection with

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\*See other courses listed under Botany and Zoology.

aspects and institutions of American life and its effects. One course. *Burford*. 1:20-2:40. 9.144.

**125. Religion and Theology of Black America.** Black religion in its historical and social context, with critical appraisal of major works. One course. *Burford*. 11:20-12:40. 9.144.

## Second Term

**145. Afro-American History.** The Black experience in America from slavery to the present. One course. *Staff*. 11:20-12:40. 9.144.

## Botany

Professor Wilbur, *Chairman* (147 Biological Sciences); Associate Professor Searles, *Director of Graduate Studies* (257 Biological Sciences); Professor White, *Director of Undergraduate Studies* (371 Biological Sciences)

Students admitted to candidacy for an advanced degree in botany should have completed a minimum of 12 semester hours of courses in botany (or biology) beyond an elementary course, and related work in biological sciences. Students who have not yet had the minimum hours, however, may enter higher courses by permission of the instructor, if he is convinced that they can carry the work for undergraduate credit, and may count such work toward hours necessary for candidacy.

### First Term (Durham Campus)

**191. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**103L. General Bacteriology.** A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public health, soil fertility, and food preservation. Prerequisite: introductory biology. One course. *Johnson*. 1:00-5:00. 58.256.

**142L/242L. Systematics.** Principles of vascular plant taxonomy with practice in collection and identification of the local flora. Lectures, laboratories, and field trips. One course. *Wilbur*. 8:00-12:00. 58.154.

**359. Research.** Credit to be arranged. *Staff*.

### First Term (Marine Laboratory, Beaufort)

**191. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**359. Research.** Credit to be arranged. *Staff*.

### Second Term (Durham Campus)

**192. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**160L/260L. Plant Anatomy.** A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolu-

tion, and the interrelationship between structure and function. Prerequisite: one year of biology or permission of the instructor. One course. *White*. 8:00-12:00. 58.138.

**359. Research.** Credit to be arranged. *Staff*.

### **Second Term (Marine Laboratory, Beaufort)**

**192. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**202L. Phytoplankton Systematics.** Taxonomy and classification of marine phytoplankton; general characteristics, phytogeography, life histories, and study techniques. Individual projects. One and one-half courses (6 graduate units). *Blankley*.

**211L. Marine Phycology.** An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half courses (6 graduate units). *Searles*.

**359. Research.** Credit to be arranged. *Staff*.

### **Third Term (Durham Campus)**

**191. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**146L/246L. Plant Ecology.** Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisite: introductory biology. One course. *Christensen*. 8:00-12:00. 58.144.

**359. Research.** Credit to be arranged. *Staff*.

### **Third Term (Duke Marine Laboratory, Beaufort)**

**191. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior years by permission of the department. Credits to be arranged. *Staff*.

**204L. Marine Microbiology.** The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton—their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. One and one-half courses (6 graduate units). *Staff*.

**359. Research.** Credit to be arranged. *Staff*.

## **Chemistry**

Professor Quin, *Chairman* (101 Paul M. Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (330 Paul M. Gross Chemical Laboratory); Professor Poirier, *Director of Undergraduate Studies* (373 Paul M. Gross Chemical Laboratory)

All classes in chemistry, Term I, will begin on May 17 and continue through



June 12. Classes in Term II will begin on June 14 and continue through July 9. Classes in Term III will begin on July 19 and continue through August 20.

### First Term

**11. Principles of Chemistry.** The introductory course for students who intend to take any additional chemistry courses other than Chemistry 103. Emphasizes stoichiometry and molecular structure. Laboratory work includes both qualitative and quantitative analysis. Prerequisites: one year of high school chemistry or Chemistry 10, and qualification for Mathematics 31. One laboratory course. *Wilder*. Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Laboratory, 65.211; lecture and recitation, 65.103.

**151. Organic Chemistry.** The structures and reactions of the compounds of carbon. Laboratory experiments illustrate the techniques of separation and structure determination. Prerequisite: Chemistry 12 or its equivalent. One laboratory course. *Jeffer*. Lecture daily, 9:30-11:30; laboratory Monday through Thursday, 12:30-4:30. Laboratory, 65.224; lecture, 65.107.

**161. Physical Chemistry.** Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Prerequisites: Chemistry 152, Physics 51, 52, and Mathematics 32. One laboratory course. *Smith*. Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Laboratory, 65.229; lecture and recitation, 65.110.

**375. Research.** Instruction in methods of investigation of original problems. Individual work and conferences. Available during Terms I, II, and III. 1 to 6 graduate units. *All Members of the Graduate Staff*.

### Second Term

**12. Principles of Chemistry.** Continuation of Chemistry 11. Emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Prerequisite: Chemistry 11 or its equivalent. One laboratory course. *Ludt*. Laboratory daily, 9:30-12:30; recitation and lecture daily, 1:30-3:30. Lecture and recitation, 65.211; laboratory, 65.103.

**152. Organic Chemistry.** Continuation of Chemistry 151. Laboratory experiments illustrate organic reactions and preparations. Prerequisite: Chemistry 151. One laboratory course. *Staff*. Lecture daily, 9:30-11:00; laboratory, Monday through Thursday, 12:30-4:30. Lecture, 65.107; laboratory, 65.224.

**240. Chemical Oceanography.** Distribution, alteration, and transport of chemical species in the marine environment. *R/V Eastward* cruise to gather samples for evaluating chemical processes in the ocean. Prerequisite: consent of instructor; knowledge of physical chemistry is recommended. (Given at Beaufort; also listed as Marine Sciences 240.) Includes lectures, laboratory work, and field trips. One and one-half laboratory courses (6 graduate units.) *Baier*.

### Third Term

**230. Environmental Oceanography.** Chemical, biological, and geological aspects of pollution in the marine environment. The interaction of man with natural marine processes on shore lines and shelves. Application of marine science to a balanced preservation and utilization of marine resources. Prerequisite: consent of the instructor; knowledge of physical chemistry is recommended. (Given at Beaufort; also listed as Marine Sciences 230.) One and one-half courses (6 graduate units). *Baier and Staff*.

## Classical Studies

Professor Oates, *Chairman* (325 Carr Building, East Campus); Associate Professor Stanley, *Director of Undergraduate Studies* (324 Carr Building, East Campus)

### CLASSICAL STUDIES

#### First Term

**53. Greek History.** The political and intellectual history of the Hellenes from earliest times to the death of Alexander the Great. (Also listed as History 53.) One course. *Oates*. 11:20-12:40. 5.219.

**137. The Roman Revolution.** Rome from the time of the Gracchi (133 B.C.) to the death of Augustus (14 A.D.). One course. *Oates*. 9:40-11:00. 5.219.

### GREEK

#### First Term

**181S. Greek Seminar.** An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff*. 8:00-9:20. B.206

**191. Independent Study.** Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff*.

### LATIN

#### First Term

**181S. Latin Seminar.** An intensive introduction to the language and literature. Open only to students who have achieved proficiency in another language. Two courses. *Staff*. 9:40-11:00. B.206.

**191. Independent Study.** Directed reading and research. Open to highly qualified juniors and seniors. *Staff*.

### GREEK

#### Second Term

**182S. Greek Seminar.** Continuation of Greek 181S. Two courses. *Staff*. 8:00-9:20. B.206.

**192. Independent Study.** Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff*.

### LATIN

#### Second Term

**182S. Latin Seminar.** Continuation of Latin 181S. Two courses. *Staff*. 9:40-11:00. B.206.

**192. Independent Study.** Directed reading and research. Open to highly qualified juniors and seniors. One course. *Staff*.

## Comparative Literature

Professor Wardropper, *Chairman of the Committee on Comparative Literature* (309 Languages Building)

### First Term

**205. The Modern: Problems of Definition, History, and Language.** The self-consciousness of literature in the "age of criticism." Representative twentieth century texts discussed as authorial confrontations with normative modern masters (Baudelaire, Flaubert, Rimbaud, Dostoevsky, Nietzsche). One course. *Rolleston*. (Not offered 1976 Summer Session.)

### Second Term

**151. Theory and Form of Tragedy.** (Also listed as French 151.) Graduate credit may be arranged. One course. *Fowlie*. 8:00-9:20. 5.014.

## Computer Science

Professor Loveland, *Chairman* (203 AROD); Professor Gallie, *Director of Undergraduate Studies* (205 AROD)

### First Term

**51. Introduction to Digital Computation.** Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming, and least-squares techniques. One course. *Patrick*. 8:00-9:20. 56.227.

### Second Term

**152. List Processing and Data Structures.** Linear lists such as stacks, queues, dequeues, circular lists, and doubly linked lists; trees; multilinked structures; dynamic storage allocation. Exercises may require use of an assembly language. Prerequisite: Computer Science 51. One course. *Trivedi*. 9:40-11:00. 56.227.

## Divinity School

Professor Langford, *Dean* (107B New Divinity School); Professor Lacy, *Associate Dean for Curricular Affairs* (101C New Divinity School)

### Third Term (August 2-September 3)

**O.T. 115-116.** Introduction to Biblical Hebrew and Exegesis. (Note: O.T. 115-116 are not credited separately.) 6 s.h. (2-5 p.m. daily). *Bailey*.

**399.** Also by special arrangement with an instructor a student may arrange for independent study in a given area of specialized research. Prerequisite: permission of the instructor and the Associate Dean.

## Drama

Assistant Professor Clum, *Director of the Duke University Drama Program* (502 Allen Building)

### First Term\*

**104. Stagecraft.** An introduction to the technical aspects of play production:

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\*See also English 124. Shakespeare.

scenery, lighting, properties, make-up, and costuming. Laboratory work coordinated with productions of Summer Theater at Duke. One course to be continued into Term II. Both terms must be taken for full credit. Mondays and Wednesdays. 3:30-5:00. Branson Theater. *Staff*.

**180S. Drama Criticism.** (Also listed as English 180S.) Readings in representative criticism. Role of the critic. Experience in writing drama criticism. One course. *Clum*. 1:30-3:00. 53.318.

**Drama 191, 193. Independent Study in Directing or Design.** Supervised projects. See Professor Clum for details. One course. *Staff*.

## Second Term <sup>†</sup>

**101. Acting.** Basic acting skills; diction, movement, improvisation, interpretation. One course. *Staff*. 1:30-3:00. 10.129.

**104. Stagecraft.** Continued from Term I. *Staff*.

**Drama 191, 193. Independent Study in Directing or Design.** Supervised projects. See Professor Clum for details. One course. *Staff*.

## Economics

Professor Kelley, *Chairman* (215 Social Sciences); Associate Professor Weintraub, *Director of Graduate Studies* (315 Social Sciences); Professor Davies, *Director of Undergraduate Studies* (302 Social Sciences)

### First Term

**51. National Income and Public Policy.** Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payments problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. One course. *Wyse*. 8:00-9:20. 10.220.

**108. Economics of War.** Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament and the economy. Prerequisite: Economics 52. One course. *Weintraub*. 11:20-12:40. 10.232.

**153. Monetary Economics.** The evolution and operations of commercial and central banking and non-banking financial institutions in the United States, determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. *Yohe*. 9:40-11:00. 10.136.

**154. Aggregative Economics.** Concepts and measurement of national income and expenditures, employment, interest rates and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. One course. *Bronfenbrenner*. 8:00-9:20. 10.227.

**318. Dissertation Seminar.** 3 units. *Weintraub*. 8:00-9:20. 10.214.

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<sup>†</sup>See also Comparative Literature 151: Theory and Form of Tragedy and English 181S: Modern Dramatic Literature.



## Second Term

**52. Competition, Monopoly, and Welfare.** A continuation of Economics 51. How the composition of the economy's output and the distribution of its income (who is rich and who is poor) are determined in a market economy by supply and demand. How and why markets work or fail to work and the implications of social policies. Role of government in a market economy: contemporary problems of the environment, topics such as environmental economics, monopoly, unionism, international trade. Comparison of a market economy with other systems of economic organization. Economic problems of developing countries. (Open only to freshmen.) One course. *Bolnick*. 9:40-11:00. 10.227.

**138. Economic Statistics.** Survey of principal concepts and methods; application to economics. (Not open to students who have had Mathematics 53 or 183, Management Sciences 110, Psychology 117.) Once course. *Wyse*. 8:00-9:20. 10.227.

**149. Microeconomic Theory.** Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) *Goalstone*. 11:20-12:40. 10.220.

## Education

Professor Flowers, *Chairman* (213I West Duke Building, East Campus, and 01 Allen Building, West Campus); Professor Petty, *Director of Graduate Studies* (205 West Duke Building, East Campus, and 116 Allen Building, West Campus); Associate Professor Colver, *Director of Undergraduate Studies* (205 West Duke Building, East Campus)

Duke University is accredited by the National Council of Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel, with the doctoral degree as the highest degree approved.

It is the intention of the department to make available to degree candidates all courses ordinarily required for certification as graduate teachers, counselors, principals, and superintendents. These courses will normally be offered at least once every three years.

## First Term

**100. Social and Philosophical Foundations of Education.** Basic features, assumptions, viewpoints, and issues of education in contemporary America. One course. *Di Bona*. 9:40-11:00. 53.225.

## Second Term

**206. Studies in the History of Educational Philosophy.** The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course (3 graduate units). *Carbone*. 2:30-3:50. A.212.

**224. Teaching the Social Studies in Elementary Schools.** One course (3 graduate units). *Cartwright*. Tuesday and Thursday, 7:00-9:45 p.m. A.202.

**225. The Teaching of History and the Social Studies.** Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course (3 graduate units). *Cartwright*. Tuesday and Thursday, 7:00-9:45 p.m. A.202.

**237. Teaching of Literature in Secondary Schools.** Conventional, adult, and transitional literature are considered. One course (3 graduate units). *Shuman*. 2:00-3:20. A.202.

**243. Personality Dynamics.** Personality structure and dynamics emphasizing implications for counseling and instruction. Prerequisite: six hours of psychology or educational psychology. One course (3 graduate units). *S. Gehman*. 8:00-9:20. A.202.

**249. Exceptional Children.** Survey of major categories of exceptional children: mentally retarded, emotionally disturbed, brain injured, learning disabled, physically handicapped, visual and auditory deficient, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment. One course (3 graduate units). *Davis*. 11:20-12:40. A.202.

**250, 251. Teaching Emotionally Disturbed Children: Internship.** Basic principles and practices in teaching and organization of instructional materials. Work with children under supervision of a certified teacher of emotionally disturbed children. Experience in general classroom, small group and individualized instruction. Participation in staff conferences with psychiatrists, psychologists, social case workers, and professional educators. Two courses (3 graduate units per course). *Gehman*. TBA.

**253. Introduction to Law and Education.** Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course (3 graduate units). *Martin*. 11:20-12:40. 4.027.

**259. Problems in Law and Education.** Current issues; researching of cases, constitutional decisions, and statutes. Prerequisite: Education 253 or consent of instructor. One course (3 graduate units). *Martin*. 9:40-11:00. 4.027.

**276. The Teaching of High School Science.** Discussion, lectures, and collateral reading, related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary school science. One course (3 graduate units). *Staff*. 2:00-3:20. A.103.

**303. Diagnostic and Educational Programs in Learning Disabilities.** Diagnostic, intervention, and remediation strategies and program development for the child with learning disabilities, review of major works in this field. Prerequisite: consent of instructor. 3 graduate units. *Davis*. 9:40-11:00. A.212.

**315. Seminar in Secondary School Teaching.** Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 graduate units. *Carbone*. 9:00-1:45. Rogers-Herr Junior High School.

**321. Educational Management.** Theory and practice of management as applied to education. For anyone who has or is preparing to have major management responsibilities in the field of education. 3 graduate units. *Pittillo*. 9:40-11:00. A.202.

**323. Public School Finance.** Educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 graduate units. *Pittillo*. 8:00-9:20. A.212.

**326. Educational Psychology: The Problem Child.** Problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid

to mental hygiene principles in the handling of problem children in school and home. 3 graduate units. *Staff*. 9:40-11:00. A.204.

**350, 351. Directed Activities in Education.** Internship experiences at an advanced level under supervision of appropriate staff. Consent of instructor. 3 graduate units per course. TBA.

### Third Term

**201. Mathematics Programs in the Elementary School.** Objectives curriculum, and instructional strategies. One course (3 graduate units). *Petty*. 8:00-9:20. 53.225.

**217. The Psychological Principles of Education.** Advanced study of teaching, learning, and the learner. One course (3 graduate units). *Weitz*. 9:40-11:00. A.212.

**223. Teaching the Language Arts.** Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. One course (3 graduate units). *Adams*. 9:40-11:00. 53.233.

**234. Secondary School Organization and Administration.** Objectives and philosophy underlying the organization and administration of the secondary school. One course (3 graduate units). *Flowers*. 8:00-9:20. 53.226.

**236. Teaching Developmental and Remedial Reading in the Secondary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course (3 graduate units). *Adams*. 11:20-12:40. 53.233.

**256. Classroom Assessment of Student Achievement.** The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course (3 graduate units). *Colver*. 11:20-12:40. A.202.

**291. Public and Community Relations of Schools.** One course (3 graduate units). *Hurlburt*. 11:20-12:40. A.212.

**332. Supervision of Instruction.** The nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 graduate units. *Hurlburt*. 9:40-11:00. A.202.

## Engineering

Professor Vesic, *Dean of the School of Engineering* (136 Engineering Building);  
Assistant Professor George, *Assistant Dean* (136 Engineering Building)

### First Term

**197-198.\* Projects in Civil Engineering.** These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: permission of the instructor and the Director of Undergraduate Studies. Each, half-course or one course. *Staff*.

**155.\* Special Topics in Electrical Engineering.** Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and the instructor. Each, half-course or one course. *Staff*.

**173.\* Projects in Electrical Engineering.** A course which may be undertaken only by seniors who are enrolled in the Graduation with Distinction

program, or who show special aptitude for individual project work. Elective for electrical engineering majors. Prerequisite: consent of the Director of Undergraduate Studies. Half-course to two courses. *Staff*.

**265.\* Advanced Topics in Electrical Engineering.** Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Graduate Studies and of instructor under whom work will be done. One course. *Staff*.

**399.\* Special Readings in Electrical Engineering.** Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 graduate units. *Graduate Staff*.

**165.\* Special Topics in Mechanical Engineering and Materials Science.**

**198.\* Projects in Mechanical Engineering and Materials Science.**

**265.\* Advanced Topics in Mechanical Engineering and Materials Science.**

**399.\* Special Readings in Mechanical Engineering and Materials Science.**

## English

Professor Budd, *Chairman* (325 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Associate Professor Butters, *Director of Undergraduate Studies* (322 Allen Building)

Candidates for the master's degree in English are expected to have had at least 18 units in undergraduate courses above the sophomore level. The department may also require additional courses if the work of the student in his first term indicates inadequate preparation.

### First Term

**24S. Studies in Poetry.** A study of the nature of poetry—its language, forms, and themes—with emphasis on British and American poetry of the twentieth century. One course. *Ferguson*. 11:20-12:40. 53.328.

**55. Representative British Writers.** Chaucer's Prologue to *The Canterbury Tales* and at least two tales, Shakespeare's *Henry IV*, *Hamlet*, or *King Lear*, and one other play, John Donne's poetry (selections), and Milton's *Paradise Lost* (selections) and some of the shorter poems. One course. *Williams*. 9:40-11:00. 53.326.

**124. Shakespeare.** About ten plays after 1600. One course. *DeNeef*. 8:00-9:20. 53.327.

**172. American Literature, 1915-1960.** Eliot, Fitzgerald, Hemingway, Faulkner, and their contemporaries. One course. *Anderson*. 9:40-11:00. 53.327.

**180S. Seminar on Drama Criticism.** (Also listed as Drama 180S.) Readings in representative criticism, role of the critic. Experience in writing drama criticism. One course. *Clum*. 11:20-12:40. 53.318.

**251. English Literature of the Twentieth Century.** Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry; Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence. One course. *Smith*. 9:40-11:00. 53.318.

### Second Term

**26S. Studies in Special Topics: The American Language.** The develop-

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\*This course will be offered Terms II and III also.



ment of current English in the United States with emphasis on its origins in Black English and the speech of other minorities; attention also to uses and abuses in advertising, government, media, and relations among the sexes. One course. *Butters*. 11:20-12:40. 53.328.

**56. Representative British Writers.** Novels by Fielding (*Joseph Andrews*), and Dickens (*Great Expectations*), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. *DeNeef*. 9:40-11:00. 53.326.

**162. American Literature from 1800 to 1860.** Prose and poetry of American Romanticism: Emerson, Thoreau, Hawthorne, Poe, Melville, and Whitman. (Not open to students who have taken 57.) One course. *Jones* 8:00-9:20. 53.327.

**181S. Conference on Drama: Modern Dramatic Literature.** An investigation of major plays and playwrights of the past twenty-five years, including plays in the repertory of Summer Theater at Duke. The focus will be on the many approaches to dramatic form and the actor-audience relationship demonstrated by modern playwrights and directors. One course. *Reardon*. 11:20-12:40. 53.318.

**195T. Field Methods in Dialectology.** For students with a previous course in linguistics who are interested in collecting and analyzing North Carolina dialect materials. Readings in linguistic theory in the first half of the term prepare the student for the practical experience of the second half. One course. *Butters*. TBA.

**209. Present-Day English.** A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course (3 graduate units). *Nygard*. 8:00-9:20. 53.326.

**252. English Literature of the Twentieth Century.** Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry; Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. One course (3 graduate units). *Smith*. 9:40-11:00. 53.327.

**276. American Literature since 1915.** Poetry from the Imagist movement to the present. One course (3 graduate units). *Duffey*. 11:20-12:40. 53.327.

### Third Term

**56. Representative British Writers.** Novels by Fielding (*Joseph Andrews*), and Dickens (*Great Expectations*), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. One course. *Monsman*. 9:40-11:00. 53.326.

**58. Representative American Writers.** Selections and complete works of James, Frost or Robinson, Crane or Dreiser, O'Neill, Faulkner, Hemingway, and others. Prospective majors should take courses numbered 161-62, 171-72 instead of this course. One course. *Reiss*. 11:20-12:40. 53.326.

**107. Introduction to Linguistics.** Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. (Also listed as Anthropology 107.) One course. *Butters*. 8:00-9:20. 53.327.

**275. American Literature since 1915.** Selected fiction from Gertrude Stein to the present. One course (3 graduate units). *Strandberg*. 9:40-11:00. 53.327.

**280. Introduction to Folklore.** A survey of the materials of popular tradition, folksong, folktale, proverb, riddle, and other forms; the methods of folklore

investigation; and the relation of these popular genres to literary tradition. One course (3 graduate units). *Nygard*. 11:20-12:40. 53.327.

## Forestry

Professor Ralston, *Dean of the School of Forestry and Environmental Studies* (213 Biological Sciences Building, West Campus); Professor Anderson, *Director of Graduate Studies* (04 Biological Sciences Building, West Campus)

The requirements for the degree of Master of Forestry (M.F.) are governed by the extent of the student's previous undergraduate education and by his specific career objectives. Students with no prior preparation in forestry are required to begin their studies with a summer term of eight weeks.

Qualified students may engage in thesis research in certain branches of forestry during the summer session with the approval of the instructor concerned and the Dean of the School of Forestry and Environmental Studies, or of the Director of Graduate Studies in the case of work taken through the Graduate School.

### Second Term

**205F. Tree Growth and Development.** Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. 3 units. *Barnes*. TBA.

**241F. Dendrology.** Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to south-eastern United States and other important forest regions of temperate North America. Prerequisite: Biology 1-2 or equivalent. 3 units. *White*. TBA.

**357. Research in Forestry.** Open to students whose research programs for the M.F. or D.F. degree have been approved by the Dean of the School of Forestry and Environmental Studies and the instructor responsible for directing the research.

### Third Term

**256F. Forest Measurements.** Applications of plane-surveying techniques to the measurement of land area, topography, and timber type; measurement of volume and growth of forest trees and stands; measurement of forest products. 4 units. *While*. TBA.

**289F. Interpretation of Aerial Photographs.** Principles of aerial photography and remote sensing as applied to forest administration, vegetation mapping, forest mensuration, and insect and disease surveys. 2 units. *Chaiken*. TBA.

## Geology

Professor Heron, *Chairman* (118 Science Building, East Campus); Professor Perkins, *Director of Graduate Studies* (111 Science Building, East Campus); Associate Professor Furbish, *Director of Undergraduate Studies* (104 Science Building, East Campus)

### First Term (Durham Campus)

**3. Environmental Geology.** Earth processes and materials, as related to man. Lectures, field trips, and eight hours of mini-lab. Not open to those who have completed Geology 1 or 12. One course. *Heron*. 11:20-12:40. C.116.

### Third Term (Duke Marine Laboratory, Beaufort)

**205. Geological Oceanography.** The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distributions, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. (This course is not open to students who have completed Geology 206.) One and one-half courses (6 graduate units). *Pilkey*.

## German

Professor Leland R. Phelps, *Chairman and Director of Graduate Studies* (106 Language Building); Associate Professors Borchardt and Rolleston; Assistant Professor Bessent, *Director of Undergraduate Studies*, and Assistant Professor Alt.

The work in German 1, 2, and 63 will be coordinated with listening and oral practice in the language laboratory.

### First Term

**1. Elementary German.** Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. One laboratory course. *Bessent*. 11:20-12:40 and Tuesdays and Fridays, 2:00-3:20. 5.109.

**63. Intermediate German.** Prerequisite: German 1-2 or two units of high school German. One laboratory course. *Bessent*. 9:40-11:00 and Mondays and Thursdays, 2:00-3:20. 5.109.

**182. German.** An intensive introduction to the language open only to students who have achieved proficiency in another language. *Alt*. 9:40-11:00. 5.08.

**191. Independent Study.** Directed reading and research. Open only to qualified students in the junior year, by permission of the department. One course. *Staff*.

**193. Independent Study.** Directed reading and research. Open only to qualified students in the senior year, by permission of the department. One course. *Staff*.

### The Duke-Vassar Summer Program in Munster, Germany.

Students can earn up to two course credits for work taken in Munster. For information on the program contact Professor Gunter Klabes, Department of German, Vassar College, Poughkeepsie, New York 12601.

### Second Term

**2. Elementary German.** Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Prerequisite: German 1 or equivalent. One laboratory course. *Alt*. 11:20-12:40 and Tuesdays and Fridays, 2:00-3:20. 5.08.

**192. Independent Study.** Directed reading and research. Open only to qualified students in the junior year by permission of the department. One course. *Staff*. Hours to be arranged.

**194. Independent Study.** Directed reading and research. Open only to qualified students in the senior year by permission of the department. One course. *Staff*. Hours to be arranged.

## Health Administration

Professor Jaeger, *Chairman* (262 Baker House); Assistant Professor Smith, *Director of Graduate Studies* (237 Baker House); Assistant Professor Warner (266 Baker House)

All courses extend throughout the summer session and are closed to students in departments other than Health Administration.

**321. Operations Research for Health Administration.** The development of a quantitative modeling framework derived from the concepts of the systems approach to analyze management decisions in health administration. The focus of the course is on the knowledge and skills needed to manage the analysis (i.e., formulation, assumption, interpretation, cost of analysis) rather than to perform the analysis. The process of analysis is emphasized over detail of techniques. Decisions are treated both deterministically and stochastically, and on a scale from simple to complex. Techniques that serve the framework include calculus, inventory theory, PERT, decision analysis, fixed vs. variable cost analysis, queueing, simulation, and mathematical programming. Examples from the field are used extensively. The latter part of the course presents the concepts of quantitative control, with the same emphasis and again with examples from the field. 4 credits. *Staff*.

**324. Institutional Health Services.** A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; planning function; and the evaluation of performance. 4 credits. *Staff*.

**326. Health Economics.** A study of the current state of knowledge with regard to the economics of health and medical care. Attention is given to the unique problems of demand and supply in the health services sector, as well as the implication of private and public financing alternatives; restrictions on man-power entry. Incentives and mobility; and problems of productivity measurement and changes. 2 credits. *Staff*.

## Health, Physical Education and Recreation

Professor Friedrich, *Chairman* (105-A Card Gym); Associate Professor Skinner, *Director of Undergraduate Instruction* (106 Card Gym)

### First Term

**PE 20. Beginning Swimming.** Basic fundamentals and strokes of swimming are taught. One-half course. 11:30-12:40. *Persons*. Card Gym.

**PE 30. Beginning Golf.** Basic fundamentals and shots in golf are taught. Students use practice driving range and putting green as well as Duke Golf Course. One-half course. 9:40-11:00. *Myers*. (Fee required.)

**PE 32. Handball-Racketball-Squash.** 9:40-11:00 a.m. One-half course. *Skinner*.

**PE 41. Intermediate Tennis.** Primary emphasis is on beginning and intermediate tennis strokes, fundamentals, and game strategy. One-half course. 9:40-11:00. *LeBar*.



**PE 163. Athletic Coaching in Secondary Schools.** (Track and Baseball). Emphasis is given to the fundamentals and theory of coaching track and baseball. One course. 1:00-2:20. *Buehler*. 104 Card Gym.

**PE 172. The Administration of Health, Physical Education, and Athletics in Secondary Schools.** A study of the organization and administration of Health, P. E. and athletic programs, facilities and staff is given. 11:20-12:40. *Friedrich*. 104 Card Gym.

**PE 173. Protective Practices in Physical Education and Athletics.** Training and conditioning of athletic teams and the prevention, diagnosis, and treatment of athletic injuries. One course. 8:00-9:20. *Riebel and Ritz*. 104 Card Gym.

## Second Term

**PE 173. Protective Practices in Physical Education and Athletics.** Training and conditioning of athletic teams and the prevention, diagnosis, and treatment of athletic injuries. One course. 8:00-9:20 a.m. *Riebel and Ritz*. Card Gym.

## History

Professor Durden, *Chairman* (235 Allen Building); Professor A. Scott, *Director of Graduate Studies* (237 Allen Building); Professor Hollyday, *Director of Undergraduate Studies* (227 Allen Building)

### First Term

**21. Europe to the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Hollyday*. 8:00-9:20. 53.225.

**53. Greek History.** (Listed also as Classical Studies 53.) One course. *Oates*. 11:20-12:40. 5.219.

**91. The Development of American Democracy to 1865.** A study of the trends vital to an understanding of the United States today. The main theme is the development of American Democracy. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered in relation to this main theme. One course. *Gavins*. 8:00-9:20. 53.226.

**118. European Imperialism and Colonialism.** The new imperialism and modernization of post-colonial societies. One course. *Cell*. 9:40-11:00. 53.229.

**136. Europe in the Twentieth Century.** Political, economic, and intellectual developments in Europe from 1933 to the present. One course. *Lerner*. 11:20-12:40. 53.233.

**239. History of Socialism and Communism.** Origins and development of socialist and communist movements. One course (3 graduate units). *Lerner*. 9:40-11:00. 53.234.

### Second Term

**22. Europe from the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Mauskopf*. 8:00-9:20. 53.234.

**92. The Development of American Democracy, 1865 to the Present.** A continuation of History 91 with emphasis upon the emergence of contemporary problems in the United States. One course. *Nelson*. 8:00-9:20. 53.226.

**114. The United States from 1920 to World War II.** One course. *Clayton*. 11:20-12:40. 53.226.

**158. The Rise of Modern Science.** The development of science and medicine with attention to cultural and social influence upon science; eighteenth to twentieth centuries. One course. *Mauskopf*. 9:40-11:00. 53.226.

**227. Recent United States History: Major Political and Social Movements.** One course (3 graduate units). *Clayton*. 9:40-11:00. 53.234.

**264. American Colonial History and the Revolution.** The background, progress, and results of the Revolution to 1789. Once course (3 graduate units). *Nelson*. 11:20-12:40. 53.234.

### Third Term

**154. Medieval England.** One course. *Young*. 8:00-9:20. 53.234.

**278. The Civil War in the United States and its Aftermath, 1861-1900.** One course (3 graduate units). *Durden*. 9:40-11:00. 53.234.

**295. Recent Interpretations in Ancient and Medieval History.** One course (3 graduate units). *Young*. 11:20-12:40. 53.234.

## Management Sciences

Professor Keller, *Chairman* (115 Social Sciences Building); Professor Dickens, *Director of Undergraduate Studies* (203 Social Sciences Building)

### First Term

**50. Elementary Theory of the Economic Enterprise.** The analysis of the internal resource allocation of the firm, market structures, and capital theory and the mathematical foundations for this analysis. Prerequisite: Mathematics 31. Not open to students who have taken Economics 2 or 52. One course. 8:00-9:20. 10.231.

**70. Analysis of Organization Behavior.** The structure and behavior of complex organization, with special reference to business firms. Topics include rationality, authority, bureaucracy; power, decision-making, informal organization, organization change; effects of technology, culture, and other environmental influences. Corequisite: Management Science 50. One course. 11:20-12:40. 10.231.

**90. Introduction to Financial Accounting.** Conceptual framework of external reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economic terms and the interpretation of published financial statements. Prerequisite: sophomore standing. Students may not receive credit for both Management Science 90 and 131. One course. 9:20-10:40. 10.231.

**231S. Intermediate Financial Accounting.** Requirements of investors, auditors, unions, and governments for information about the status and operations of firms and a framework for disclosure of the relevant data. Prerequisites: Management Science 131. One course. 8:30-10:10. 10.229.

**145. Federal Income Taxation.** Principles of federal income tax laws related to corporation and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite: Management Science 90 or 131. One course. 10:30-12:10. 10.229.

## Second Term

**110. Probability and Statistics.** Probability theory and distributions. Classical statistical analysis and its application to decision problems. Topics include estimation, hypothesis testing, regression and correlation analysis. Not open to students who have taken Public Policy Studies 112, Economics 138, Mathematics 53, or Engineering 150. Prerequisite: Mathematics 31. Corequisite: Management Science 50. One course. 8:00-9:20. 10.231.

**232S. Internal Control and Auditing.** The independent auditor's examination of the accounting control system and other evidence as a basis for expressing an opinion on a client's financial statements. Basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Science 137, 231. One course. 8:30-10:10. 10.232.

**234S. Advanced Financial Accounting.** Accounting for and reporting on the diverse activity of multi-product, multi-divisional, multi-national organizations. Organizations with and without profit goals are studied. Prerequisite: Management Science 137, 231. One course. 10:30-12:10. 10.229.

**391.1. Special Topics in Management.** Examination of a specialized area in the field of management. Credit hours to be arranged. 8:30-9:20. 10.229.

**312. Operations Research.** Deterministic and probabilistic models useful in the analysis of management problems, with particular emphasis on model formulation, information requirements, model validation, sensitivity analysis, and utilization of model outputs in problem-solving. Topics include: mathematical programming, decision-making under uncertainty, and digital simulation. 5:00-9:00, Monday and Thursday, May 10-August 20.

**341. External Environment of the Firm.** An examination of the way in which society, through the mechanism of government, affects the decisions of business firms. Attention is focused on macroeconomic, legal, and social factors in the firm's environment. 5:00-9:00, Monday and Thursday, May 10-August 20.

**333. Controllanship.** The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 5:00-9:00, Monday. May 10-August 20.

**361. Marketing Management.** Analysis of the firm's general market competitive and cooperative strategy problem. Specific problem areas include pricing, product and product line design, promotion, logistics, research, the relationship among these various problem areas, and their solutions. 5:00-9:00, Tuesday. May 10-August 20.

**391.2. Special Topics in Management.** Examination of a specialized area in the field of management. Credit hours to be arranged. 5:00-9:00, Thursday. May 10-August 20.

**318. Calculus for Management.** An introductory treatment of calculus for graduate students in management. 5:00-6:40, Monday, Tuesday, Thursday. July 19-August 27.

**Problem Session.** 7:20-9:00, Monday, Tuesday, Thursday. July 19-August 27.

## Mathematics

Professor Warner, *Chairman* (135C Physics Building); Professor Weisfeld, *Director of Graduate Studies* (230 Physics Building); Professor Murray, *Director of Undergraduate Studies* (135A Physics Building)

### First Term

**31. Introductory Calculus.** Limits, differentiation, and integration with applications to physical problems. Prerequisite: three years of college preparatory mathematics. One course. *Staff.* 11:20-12:40. 49.132.

**53. Basic Statistics.** Statistical concepts involved in making inferences, decisions, and predictions from data. Techniques not emphasized. Not open to students who have had Economics 138 or Psychology 117. One course. *Staff.* 9:40-11:00. 49.132.

### Second Term

**19. Pre-Calculus Mathematics.** Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two years of college preparatory mathematics. One course. *Staff.* 8:00-9:20. 49.132.

**31. Introductory Calculus.** (For course description see listing under first term.) One course. *Staff.* 9:40-11:00. 49.132.

**32. Introductory Calculus.** Transcendental functions, sequences, series, Taylor's formula. Prerequisite: Math 31. One course. *Staff.* 11:20-12:40. 49.132.

**216. Intermediate Analysis.** Series; uniform convergence, integration. Theory of functions of a real variable. One course (3 graduate units). *Staff.* 8:00-9:20. 49.124.

**220. Advanced Linear Algebra with Applications.** Solutions of systems of linear inequalities; applications to linear programming and game theory; computation of eigenvalues and eigenvectors. One course (3 graduate units). *Staff.* 9:40-11:00. 49.124.

### Third Term

**19. Pre-Calculus Mathematics.** For course description see listing under second term. One course. *Staff.* 9:40-11:00. 49.124.

**32. Introductory Calculus.** For course description see listing under second term. Prerequisite: Mathematics 31. One course. *Staff.* 11:20-12:40. 49.124.

**204. Geometry for Teachers.** Metric and synthetic approaches to plane and solid geometry; affine geometry, an algebraic model of Euclidean geometry. One course (3 graduate units). *Staff.* 9:40-11:00. 49.128.

**219. Advanced Modern Algebra.** Fields, vector spaces, and groups; Galois theory; theory of equations. Prerequisite: some familiarity with modern algebra and linear algebra. One course (3 graduate units). *Staff.* 11:20-12:40. 49.128.

## Microbiology and Immunology

Professor Joklik, *Chairman* (Research Park IV); Professor Willett, *Director of Graduate Studies* (111 Research Park IV)



The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

### First Term

**212. Research Techniques in Microbiology and Immunology.** An introduction to biochemical, immunologic, and cell culture techniques with emphasis on approaches to contemporary problems in molecular and cellular biology. Prerequisites: Biochemistry 247 or equivalent, and permission of instructor. Offered only in the summer. 1 unit. *Dawson, Vanaman, and Staff.*

**213. Research Techniques in Microbiology and Immunology.** Continuation of 212. Open only to graduate students in Microbiology and Immunology. 1 unit. *Dawson, Vanaman, and Staff.*

### Second Term

**325. Medical Mycology.** Comprehensive lecture and laboratory coverage of all the fungi pathogenic for humans. Practical aspects as well as future trends in the mycology, immunology, diagnosis, pathogenesis, and epidemiology of each mycotic agent will be explored. There will be several invited lecturers, each an internationally recognized scientist, discussing their particular areas of mycological expertise and current research. Prerequisite: permission of instructor. Enrollment limited to 20. July 6-30, 1976. *Dr. Mitchell.* 8:30-12:00, Monday-Friday, Lecturer, M-312 Davison; Laboratory, M-410 Davison.

## Music

Associate Professor Tirro, *Chairman* (105C Biddle Music Building); Assistant Professor Henry, *Director of Undergraduate Studies* (078 Biddle Music Building)

### First Term

**125. Masterworks of Music.** Historical, biographical, and analytical study of works by major composers of the seventeenth through the twentieth centuries. One course. *Henry.* 8:00-9:20. E.104.

### Second Term

**65. Fundamentals of Music Theory.** Physical properties of sound; principles of diatonic tonal organization; melodic and harmonic constructions; elementary counterpoint and figured bass. Skill course. Prerequisite: basic knowledge of musical notation and vocabulary. One course. *Maves.* 8:00-9:20. E.104.

**181, 182. Independent Study in Musical Performance.** Intensive coaching and performance in chamber music at Kneisel Hall, Blue Hill, Maine. See Music Department for dates and fees. Two courses. *Mueller.*

## Nursing

Professor Wilson, *Dean* (1005 School of Nursing, West Campus); Associate Professor Most, *Director of Academic Programs* (1004 School of Nursing, West Campus)

## First Term

**121S. Parenthood.** An investigation of parenting behavior with a focus on the meaning of experiences to the mother and father and the means by which individuals can maximize the positive potential of these experiences. Permission of instructor necessary. One course. Pass/fail option. *Harris*. 9:40-11:00. To be arranged.

**169. Human Sexuality.** A study of the intrapersonal, interpersonal, and sexual aspects of an individual's existence and the forces shaping prevailing and future sexual expressions and human sexuality. Open to non-nursing majors. Permission of the instructor required. One course. Pass/fail option. *Woods*. To be arranged.

**179. Nursing in Nephrology.** Planned experience providing nursing care for patients with clinical disturbances of renal function utilizing current treatment modalities in a variety of treatment settings. Open to rising seniors. One course. Pass/fail option. *Brundage*. 8:00-10:00. Clinical time to be arranged.

**191, 192, 193, or 194. Independent Study.** Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Permission of instructor required. Minimum one course. Pass/fail option. *Staff*.

**244. Theories of Group Psychotherapy.** Theories of group psychotherapy based on psychoanalytic, interpersonal, communication, and group dynamic theories of psychiatry as pertinent to the practice of group psychotherapy by nurses. Exposure to and discussion of: differing models and types of group therapy, basic principles and techniques of group therapy, and the role of the psychiatric nurse in this treatment modality. Permission of instructor required. Minimum one course or three units. *White*. Wednesday, Thursday. 9:00-11:30. To be arranged.

**286. Thanatology.** An indepth exploration of man's relationship to death. The course emphasizes feelings about death and examines and integrates clinical and theoretical materials from the social sciences and helping professions. One course or four units. *Gelein*. Tuesday. 8:30-10:00. Wednesday, Thursday. 9:00-12:00. Sixty hours clinical experience to be arranged.

**390. Clinical Practicum.** (Continued in Terms II and III.) Ten units. *Hogue*. Tuesday. 10:00-12:00. Clinical time to be arranged.

**391, 392, or 393. Independent Study.** An opportunity for the student to fit the curriculum to individual learning goals, both substantively and methodologically, and to demonstrate competence in self-directed learning. Minimum three units. *Staff*. To be arranged.

**395 or 396. Master's Thesis.** Three units each. *Staff*. To be arranged.

## Second Term

**191, 192, 193 or 194. Independent Study.** (See description given in Term I.) *Staff*.

**244. Theories of Group Psychotherapy.** Continued from Term I. *White*.

**390. Clinical Practicum.** Continued from Term I. *Staff*.

**391, 392 or 393. Independent Study.** (See description given in Term I.) *Staff*.

**395 or 396. Master's Thesis.** *Staff*.

### Third Term

**191, 192, 193 or 194. Independent Study.** (See description given in Term I.) May be continued from Terms I and II. *Staff.*

**390. Clinical Practicum.** Continued from Terms I and II. *Staff.*

**391, 392, or 393. Independent Study.** (See description given in Term I.) *Staff.*

**395 or 396. Master's Thesis.** *Staff.*

## Pathology

Professor Jennings, *Chairman* (M301 Davison Building); Professor Sommer, *Director of Graduate Studies* (M301 Davison Building)

### First Term

**357. Research.** Hours to be arranged. *Staff.*

**361. Advanced General Pathology.** See *Bulletin of the Graduate School* for description. 6 units. *Staff.*

### Second Term

**357. Research**

**362. Advanced General Pathology.** Second part of Pathology 361.

### Third Term

**357. Research.** Hours to be arranged. *Staff.*

## Philosophy

Professor Peach, *Acting Chairman* (201E West Duke Building, East Campus); Associate Professor Roberts, *Director of Graduate Studies* (201B West Duke Building, East Campus); Assistant Professor Ross, *Director of Undergraduate Studies* (201G West Duke Building, East Campus)

### First Term

**43S. Introduction to Philosophy.** Examination of problems in philosophy; emphasis on metaphysics and theory of knowledge. One course. *Sanford.* 9:40-11:00. 9.129.

**48. Logic.** A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Sanford.* 11:20-12:40. 9.129.

### Second Term

**112S. Philosophy of Mind.** Such topics as mind and body, thought, perception, persons, and personal identity. One course. *Welsh.* 11:20-12:40. 9.129.

### Third Term

**44S. Introduction to Philosophy.** Examination of problems in philosophy; emphasis on ethics and value theory. *Boudreaux.* 11:20-12:40. 9.129.

## Physics

Professor Walker, *Chairman* (119 Physics Building); Associate Professor Evans,

*Director of Graduate Studies (111 Physics Building); Associate Professor Roberson, Director of Undergraduate Studies (412 TUNL)*

### First Term

**33. Energy: Principles, Problems, Alternatives.** Basic principles of physics as related to energy, the energy crisis, possible sources and alternatives, conservation, and environmental aspects of energy consumption. Optional special topics laboratory. No previous knowledge of physics assumed. One course. *Robinson*. 9:40-11:00. 49.113.

**51. General Physics.** Basic principles of general physics treated quantitatively. Designed for students entering medicine, engineering, and the sciences. Not open for credit for students who have completed Physics 41, 42 in their freshman year. Prerequisites: Mathematics 31, 32, or equivalent (may be taken concurrently with consent of instructor). One laboratory course. *Evans*. 9:40-4:00. 49.114.

### Second Term

**52. General Physics.** A continuation of Physics 51. Prerequisite: Physics 51. One laboratory course. *Evans*. 9:40-4:00. 49.114.

### Third Term

**55. Introduction to Astronomy.** Man's evolving theory of the physical universe. Cosmological models, galaxies, stars, interstellar matter, the solar system, and experimental techniques and results. Optional observational laboratory. One course. *De Lucia*. 8:00-9:20. 49.113.

**255. Astronomy for Teachers.** Observational techniques and the use of telescopes. Evolution of planetary atmospheres and interiors, stellar evolution, galaxies, cosmology. Observatory observation. One course. *De Lucia*. 8:00-9:20. 49.113.

## Physiology

*Associate Professor Salzano, Acting Chairman (388 Medical Sciences I); Professor Ottolenghi, Director of Graduate Studies (453 Medical Sciences I)*

### Second Term (Duke Marine Laboratory, Beaufort)

**222. Marine Electrobiolgy.** The physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysiological studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. The ionic basis of bioelectric signals, the transmission of signals within and between cells, the relation of bioelectric signals to particular behavior patterns, the effects of externally applied electric fields, and bioelectric communication and navigation systems. Prerequisite: consent of instructor. One and one-half courses (6 graduate units). *Wachtel and Wohlbarsht*.

## Political Science

*Professor Barber, Chairman (214 Perkins Library); Associate Professor Johns, Director of Graduate Studies (214 Perkins Library); Professor Hall, Director of Undergraduate Studies (314 Perkins Library)*



## First Term

**127. Law and Politics.** Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators, and administrators in the development of public as well as private law. One course. *Fish*. 8:00-9:20. 4.301.

**128S. Congress and the Presidency.** Policy-making in the executive and legislative branches of the U. S. government, with particular attention to intragovernmental relations. One course. *Price*. 11:20-12:40. 4.307.

**131. Introduction to American Political Thought.** Basic elements in the American political tradition as developed from its English roots to the present. One course. *Leach*. 9:40-11:00. 4.301.

**160. Quebec History and Politics in French Canadian Literature.** The political and historical realities of French Canada as seen through the evolution of the French Canadian novel from the beginning to the present (Lacombe to Langevin). Special attention will be given to the development of French Canadian and Quebec nationalism. Readings and written work in French or English. Class discussions in English. (Also listed as French 131.) One course. *Gill*. 9:40-11:00. 5.211.

## Second Term

**94. Contemporary Political Ideologies.** Liberalism, socialism, Marxism and its variants, fascism, contemporary democratic theory. One course. *Spragens*. 8:00-9:20. 4.301.

**176. Urban Politics.** Urban political processes and their impact upon urban policy. One course. *Salamon*. 9:40-11:00. 4.301.

## Third Term

**241. Public Administrative Organization and Management.** The American administrative process: theory and practice of administrative organization and management. One course (3 graduate units). *Hall*. 9:40-11:00. 4.301.

## Psychology

Professor Alexander, *Chairman* (244 Sociology-Psychology); Professor Staddon, *Director of Graduate Studies* (242 Sociology-Psychology); Professor Wing, *Director of Undergraduate Studies* (316 Sociology-Psychology)

## First Term

**102. Sensation, Perception, and Learning.** Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherrington) and behavioral (Pavlov). Complex organization: learning, perception, and cognition. One course. *Lockhead*. 11:20-12:40. 9.127.

**138. Abnormal Psychology.** Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 104 or 105. One course. *Lakin*. 9:40-11:00. 9.126.

**165S. Personality Theory.** Theories of personality from larger metatheoretical perspectives. Open to junior and senior majors in psychology, or by permission of the instructor. Prerequisite: Psychology 104. One course. *Lakin*. 8:00-9:20. 9.129.

## Second Term

**104. Personality.** Representative theories of personality from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. One course. *Carson*. 9:40-11:00. 9.126.

**105. Developmental Psychology.** Theory and research on growth and behavior from infancy to adolescence. One course. *Whatley*. 8:00-9:20. 9.126.

**111. Social Psychology.** Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisite: one course in Psychology 102, 103, 104, 105 or permission of the instructor. One course. *Aderman*. 11:20-12:40. 9.126.

## Third Term

**103. Biological Basis of Behavior.** Behavior as a product of evolution and the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Kalat*. 11:20-12:40. 9.127.

## Religion

Professor Poteat, *Chairman* (117B Gray); Professor Smith, *Director of Graduate Studies* (209A Divinity); Professor Osborn, *Director of Undergraduate Studies* (324 Gray)

### First Term

**52. The New Testament.** Origins, development, and content of thought. Not open to students who have had Religion 55 or 55D. One course. *Price*. 8:00-9:20. 3.220.

**143. Mysticism.** The mystical element in religion: Hinduism, Buddhism, Christianity and Islam. One course. *Bradley*. 11:20-12:40. 3.220.

**195B. Seminar on Themes in Modern Jewish Thought.** One course. *Bland*. 9:40-11:00. 3.220.

### Second Term

**57. Introduction to Religions of Asia.** Problems and methods in the study of religion, followed by a survey of the historical development, beliefs, practices and contemporary significance of the Islamic religion and religions of South and East Asia. One course. *Lawrence*. 9:40-11:00. 3.220.

**124. Christianity in America.** Representative people, movements, and thought in American Christianity. One course. *Jones*. 8:00-9:20. 3.220.

### Third Term

**141. Religions of China and Japan.** Traditional religion in China and Japan and its interaction with Sino-Japanese Buddhism. One course. *Corless*. 9:40-11:00. 3.220.

## Romance Languages

Professor Tetel, *Chairman* (205 Languages Building); Associate Professor Vincent, *Director of Graduate Studies* (214 Languages Building)

## FRENCH

### First Term

**1. Elementary French.** Understanding, reading, and writing French. Language laboratory available for recording-listening practice. (Also equivalent to the Graduate Reading Course.) One course. *Staff*. 9:40-11:00. 5.208.

**100. Active French.** Conversation and exposes on contemporary subjects. Prerequisite: French 76 or consent of instructor. One course. *Steegar*. 9:40-11:00. 5.217.

**131. Quebec History and Politics in French Canadian Literature.** The political and historical realities of French Canada as seen through the evolution of the French Canadian novel from the beginning to the present (Lacombe to Langevin). Special attention will be given to the development of French Canadian and Quebec nationalism. Readings and written work in French or English. Class discussion in English. (Also listed as Political Science 160.) One course. *Gill*. 9:40-11:00. 5.211.

**141S. French Literature: Women in France, Myths and Facts.** Readings from literature, journalism, and sociology. One course. *Bryan*. 11:20-12:40. 5.217.

### Second Term

**2. Elementary French.** Reading and writing French. One course. *Ripley*. 11:20-12:40. 5.219.

**151. Theory and Form of Tragedy.** A study of major theorists and an analysis of principal Greek, French and English tragedies. (Also listed as Comparative Literature 151.) One course. *Fowlie*. 8:00-9:20. 5.014. Graduate credit may be arranged.

## SPANISH

### First Term

**1. Elementary Spanish.** Understanding, reading, and writing Spanish. Language laboratory available for recording-listening practice. One course. *Landeira*. 11:20-12:40. 5.211.

**141S. Spanish Literature: The Inquisition and the Civil War (1936)—Focal Points of Spanish Civilization.** An abbreviated critical look at two distinct and often misunderstood national crises. Readings in Spanish and English. One course. *Landeira*. 9:40-11:00. 5.305.

**153S. Spanish Language and Culture.** Summer program in Spain. One course. *Garci-Gomez*.

**191. Independent Study.** Directed reading and research. Summer program in Spain. One course. *Garci-Gomez*.

### Second Term

**2. Elementary Spanish.** Reading and writing Spanish. Readings in modern literature. One course. *Staff*. 11:20-12:40. 5.211.

**100. Active Spanish.** Conversation and written expression emphasizing oral communication. Prerequisite: Spanish 76 or consent of instructor. Limited to fifteen students. One course. *Staff*. 9:40-11:00. 5.208.

## ITALIAN

### First Term

**284. Dante.** A close reading of the *Inferno*. Conducted in English. Reading in Italian or English. One course. *Caserta*. 11:20-12:40. 5.305.

### Second Term

**285. Dante.** A critical reading of selections from the *Purgatorio* and the *Paradiso* conducted in the light of Dante's cultural world. Special attention will be given to the poetic significance of the *Commedia*. Conducted in English. One course. *Caserta*. 11:20-12:40. 5.305.

## Science and Mathematics Institute for Teachers

These courses, for both prospective and practicing teachers, will be offered if demand is adequate. If at all interested, write immediately to Professor Sherwood Githens so that enrollments can be assessed at an early date. All but Chemistry 213-214 may be taken by a teacher who did not major in the named field, in order to broaden his preparation to teach. May be applied toward M.Ed. degree and the cooperative M.A.T. degree described on page 7. Some state scholarships for tuition may be available to teachers under contract in a North Carolina public school.

### Second Term

**Chemistry 211-212. Environmental and Applied Chemistry for Teachers.** Study of modern chemistry with particular reference to environmental, ecological, and interdisciplinary aspects of modern technology. For teachers of biology, chemistry, and general science. Lecture, laboratory, field trips. 6 graduate units.

### Third Term

**Physical Science 201, 202. Physical Science for Teachers, I and II.** Study of the major topics of introductory physics (I) and chemistry (II) with emphasis on laboratory work suitable for grades 9 through 12. Lecture and laboratory. 3 graduate units per course.

See also Physics 255 (Astronomy), Computer Science 251, Education 246, 256 and 276.

## Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology); Professor Smith, *Director of Graduate Studies* (332 Sociology-Psychology); Associate Professor House, *Director of Undergraduate Studies* (277A Sociology-Psychology)

### First Term

**144. Political Sociology.** Politics as social behavior involving change in institutions and structures; current national and local issues. One course. *Portes*. 9:40-11:00. 9.248.

**172. Collective Behavior.** Rumor and contagion as general process; collective expression such as riots, protests, and behavior in disaster. Focus on contemporary Western society. One course. *Portes*. 11:20-12:40. 9.248.

### Second Term

**173. Social Movements.** Social movements as agents of change. Structure and development of protest groups. One course. *Wilson*. 8:00-9:20. 9.248.



**278. Social Structure and the Life Cycle.** A study of the relationship between age as a social characteristic and social interaction with particular reference to adolescence and old age. One course. *Cutler*. 9:40-11:00. 9.248.

### Third Term

**259. Religion and Social Change.** The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). Prerequisite: either Anthropology 264, Sociology 151, or the equivalent. One course. *Tiryakian*. 8:00-9:20. 9.248.

## Zoology

Professor Fluke, *Chairman* (227 Biological Sciences); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences); Associate Professor Ward, *Director of Undergraduate Studies* (032 Biological Sciences)

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking B.A., B.S., M.A., or Ph.D. degrees.

Students seeking undergraduate degrees should consult the *Bulletin of Undergraduate Instruction* for a statement of major requirements. A departmental handbook available from the office of the Director of Undergraduate Studies describes the advising system, typical courses of study, special programs, and interests and background of the faculty.

In general, a graduate student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology, along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, Anthropology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

For registration dates see the General Registration section of this *Bulletin*. For detailed instructions and further information on the offerings at Beaufort, see the *Bulletin of the Duke University Marine Laboratory*.

### First Term (Durham Campus)

**117. Genetics and Society.** An introduction to genetics with emphasis on the effects of environment and heredity upon the individual and the population. Students may not receive credit for both Zoology 117 and 180 or Nursing 105. Prerequisite: introductory biology or consent of instructor. One course. *Ward*. 9:30-11:10, Monday through Friday. 58.113.

**191. Independent Study.\*** For senior and junior majors with permission of

the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**193T.\* Tutorial.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**353.\* Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*.

### **First Term (Duke Marine Laboratory, Beaufort)**

**114L. Introduction to Biological Oceanography.** Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: introductory biology. One and one-half courses. *Cox*.

**191.\* Independent Study.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**193T.\* Tutorial.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**353.\* Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*.

### **Second Term (Durham Campus)**

**160. Principles of Cell Biology.** Structure and function of organelles, metabolism, and regulatory mechanisms. Lectures. Prerequisites: introductory biology and Chemistry 12. One course. *Wheeler*. 9:30-11:10, Monday through Friday. 58.130.

**160L. Principles of Cell Biology.** See Zoology 160. Lectures and laboratories. One course. *Wheeler*. 9:30-11:10, Monday through Friday. 58.130; laboratory, 2:00-5:00, Monday through Wednesday. 58.048.

**192. Independent Study.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**194.\* Tutorial.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**354.\* Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*.

### **Second Term (Duke Marine Laboratory, Beaufort)**

**192.\* Independent Study.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**194T.\* Tutorial.** For senior and junior majors with permission of the Di-

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\*Section numbers and professors teaching each section are listed as follows:

42—Bailey; 44—Barber; 48—Bookhout; 50—Costlow; 52—Fluke; 54—Forward; 56—Gillham; 58—Gregg; 62—Livingstone; 64—Lundberg; 66—McClay; 68—Nicklas; 70—Schmidt-Nielsen; 74—Tucker; 76—Vogel; 78—Wainwright; 80—Ward; 82—H. Wilbur; 84—K. Wilbur.

rector of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**203L. Marine Ecology.** Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology and calculus. Knowledge of statistics helpful. One and one-half courses (6 graduate units). *Staff*.

**250L. Physiological Ecology of Marine Animals.** The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. One and one-half courses (6 graduate units). *Forward*.

**278L. Invertebrate Embryology.** Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Bookhout*.

**354.\* Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*.

### Third Term (Durham Campus)

**191.\* Independent Study.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**193T.\* Tutorial.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**353.\* Research.** To be carried on under the direction of of the appropriate staff members. Hours and credits to be arranged. *Staff*.

### Third Term (Duke Marine Laboratory, Beaufort)

**191.\* Independent Study.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**193T.\* Tutorial.** For senior and junior majors with permission of the Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*.

**214L. Biological Oceanography.** Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Barber*.

**274L. Marine Invertebrate Zoology.** Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: introductory biology. One and one-half courses (6 graduate units). *Barnes*.

**353.\* Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*.

\*Sections same as 191, Term I.

## Calendar of the Summer Session

1976

**First Term: May 11-June 12**  
**Second Term: June 14-July 16**  
**Third Term: July 19-August 20**

<b>May</b>	11	Tuesday—Summer Session begins
	17	Monday—First class day for chemistry and physics
<b>June</b>	12	Saturday—First Term ends
	14	Monday—Term II of Summer Session begins
<b>July</b>	9	Friday—Classes end in chemistry and physics
	16	Friday—Second Term ends
	19	Monday—Term III of Summer Session begins
<b>August</b>	20	Friday—Third Term ends

## Directions to Summer Session Applicants

All applicants for summer session courses who are not now in residence at Duke University must fill out accurately and in detail the application form and return it to the Director of the Summer Session. Preference in enrollment will be given to persons returning the form promptly, but a place in a particular course cannot be assured until all fees are paid. Undergraduates or graduates who are enrolled in a university or college other than Duke University and who are seeking a transfer summer session credits to the college in which they are matriculated should request a course approval form to be certified by their dean or registrar. Graduate students are reminded that credit earned as an unclassified graduate student cannot be applied toward an advanced degree at Duke University. Persons applying for admission to the Graduate School of Duke University should write the Dean of the Graduate School for the necessary forms in addition to completing the application form in this *Bulletin*.

Undergraduates, both men and women, are required to live in the residence halls unless they are married or living with parents or relatives or have received permission to reside off campus for the previous or subsequent academic year. Any exception must be approved in advance by the Dean of Students.

Mail applications to Director of the Summer Session, 116 Allen Building, Duke University, Durham, North Carolina 27706.



# Application for Enrollment in the Duke University Summer Session

Mr., Ms. \_\_\_\_\_ (Please Print)  
Street Address, Rural Route, or P.O. Box \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip Code \_\_\_\_\_  
Social Security No. \_\_\_\_\_ Phone, Area \_\_\_\_\_ / \_\_\_\_\_

Please register me in the following courses listed in the *Bulletin of the Summer Session, 1976.*

Term	Dept.	Course. No.	Course Title
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Name and address of high school from which you graduated \_\_\_\_\_  
\_\_\_\_\_

Have you attended a college? Yes \_\_\_\_\_ No \_\_\_\_\_

Name and address of college \_\_\_\_\_  
\_\_\_\_\_

Highest degree held \_\_\_\_\_

Are you a candidate for a degree? Yes \_\_\_\_\_ No \_\_\_\_\_

If yes, for which degree? \_\_\_\_\_

Circle the one below which indicates your present University status. (Do not indicate a status in a Duke University School or College unless you have already been admitted to that School or College.)

*Undergraduate Credits*

- Trinity College of Arts and Sciences
- School of Nursing
- School of Engineering
- Special or Unclassified
- Credits for Transfer

*Graduate Credits*

- Graduate School
- Divinity School
- School of Forestry
- Special or Unclassified
- Credits for Transfer

Are you applying for admission to the Duke Graduate School? \_\_\_\_\_

Are you at present a college student? \_\_\_\_\_ If so, where? \_\_\_\_\_  
\_\_\_\_\_

What class? \_\_\_\_\_

See Reverse

Are you a full-time teacher? \_\_\_\_\_

If so, give name and address of school and school system \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Teaching Position:

Elementary: \_\_\_\_\_

Secondary: \_\_\_\_\_

Administrator: \_\_\_\_\_

Supervisor: \_\_\_\_\_

Have you attended previous Summer Sessions at Duke? Yes \_\_\_\_\_ No \_\_\_\_\_

Years of attendance \_\_\_\_\_

Do you wish credit certified to some agency or school? Yes \_\_\_\_\_ No \_\_\_\_\_

If yes, please give exact name and address of agency or school \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Do you have any medical disabilities which would require special treatment or facilities?

Yes \_\_\_\_\_ No \_\_\_\_\_ Please explain \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Mail To: Director of the Summer Session  
116 Allen Building  
Duke University  
Durham, North Carolina 27706

# MAP OF DUKE UNIVERSITY

## East Campus

A Baldwin Auditorium  
B Bassett House  
C Brown House  
D Union Building  
E Faculty Apartments  
F Art Museum, Geology  
G Aycock House  
H East Duke Building  
I West Duke Building  
J Jarvis House  
K Carr Building  
L Giles House  
M Woman's College Library  
N Alspaugh House

O Pegram House  
P Duke Press  
Q Infirmary  
R Ark  
S Crowell Building  
T Epworth Inn  
U Gilbert Addams House  
V Southgate Hall  
W Campus Center  
X Woman's College  
Y Asbury Building  
Z Brins Building  
AA Art Building  
BB Branson Building



## West Campus

A Duke Chapel  
B Divinity School  
C Gray Building  
D Perkins Library  
E Language Center  
F Old Chemistry Building  
G Davison Building  
School of Medicine

H Hospital Main Entrance  
I Gerontology, D & T,  
Clinical Research  
J Duke Hospital  
K Sociology, Psychology  
L Social Sciences  
M Allen Building  
N Few Quadrangle

D Craven Quadrangle  
P Wannamaker Hall  
Q Crowell Quadrangle  
R Clock Tower Court  
S Kilgo Quadrangle  
T Union Building  
U Flowers Building  
Page Auditorium

V Card Gymnasium  
W Indoor Stadium  
X School of Law  
Y Gross Chemical Laboratory  
Z Biological Sciences  
AA Plant Environment  
Laboratory  
BB Physics Building  
CC Nuclear Laboratory  
DD School of Engineering  
EE Army Research  
FF Medical Center Research  
Buildings  
GG Nansline H. Duke Medical  
Sciences Building  
HH Warehouse, Shop  
II Bell Building  
JJ Hanes House  
KK School of Nursing  
LL Hanes House Annex  
LL Pickens Rehabilitation  
Center  
MM Graduate Center  
NN Alumni House  
OD Commonwealth Studies  
Center  
PP Personnel Office  
QQ International House  
RR Personnel Office  
SS Education Improvement  
Program  
A Better Chance Program  
TT International Studies  
Center  
UU Campus Stores Office  
VV Office of Institutional  
Advancement  
WW Information Services  
Visitors Bureau  
XX Admissions Office  
YY Edens Quadrangle  
ZZ Wade Stadium







# Bulletin of Duke University

Marine Laboratory  
Beaufort, North Carolina

1976-1977







# Bulletin of Duke University

**Marine Laboratory**

**1976-1977**

Beaufort, North Carolina 1975

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson  
Duke University Bulletins Office

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Marty Farmer  
Duke University Marine Laboratory

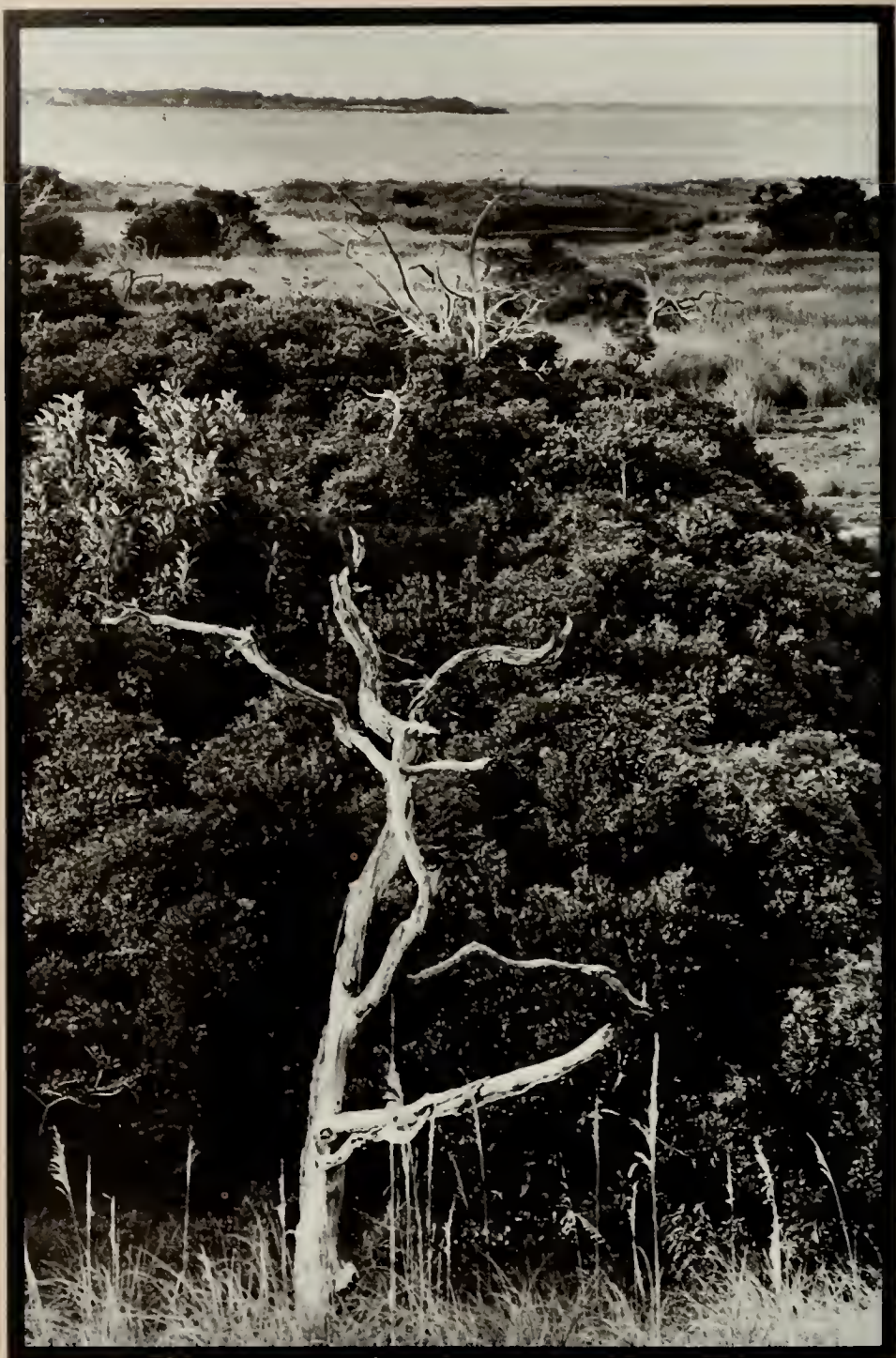
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## Contents

<b>General Information</b>	1
<b>Resources for Study</b>	2
Flora and Fauna	3
Research Interests	3
Research Facilities	5
<b>Financial Information</b>	8
Tuition	9
Research Space	9
Living Accommodations	10
Dining Facilities	11
Boat Rentals	11
Other Financial Information	12
Teaching Assistantships	13
<b>Admissions</b>	14
<b>Courses of Instruction</b>	16
First Summer Term	17
Second Summer Term	18
Third Summer Term	19
Spring Semester—Undergraduate Program	21
<b>Seminars</b>	22
<b>Publications</b>	28
<b>Appendix</b>	34
Application Form—Summer Sessions	45
Application Form—Undergraduate Program	47



## General Information



## The Laboratory

Through the efforts of Dr. A. S. Pearse, the Duke University Marine Laboratory was founded in 1938 on Pivers Island near the town of Beaufort, North Carolina. It was established initially to offer teacher training at the senior-graduate level, but research soon became an integral part of the program. Studies are currently being conducted in the fields of ecology, systematics, physiology, embryology, mycology, algology, and biological, chemical, geological, and physical oceanography. In addition to the graduate program, a newly established interdisciplinary program in the marine sciences now makes it possible for qualified undergraduates to spend the spring semester at the Laboratory.

The Duke University Marine Laboratory presently occupies fifteen acres of the southern portion of Pivers Island; the U. S. Department of Commerce, NOAA, National Marine Fisheries Service, Center for Menhaden Research are located on the remainder of the island.

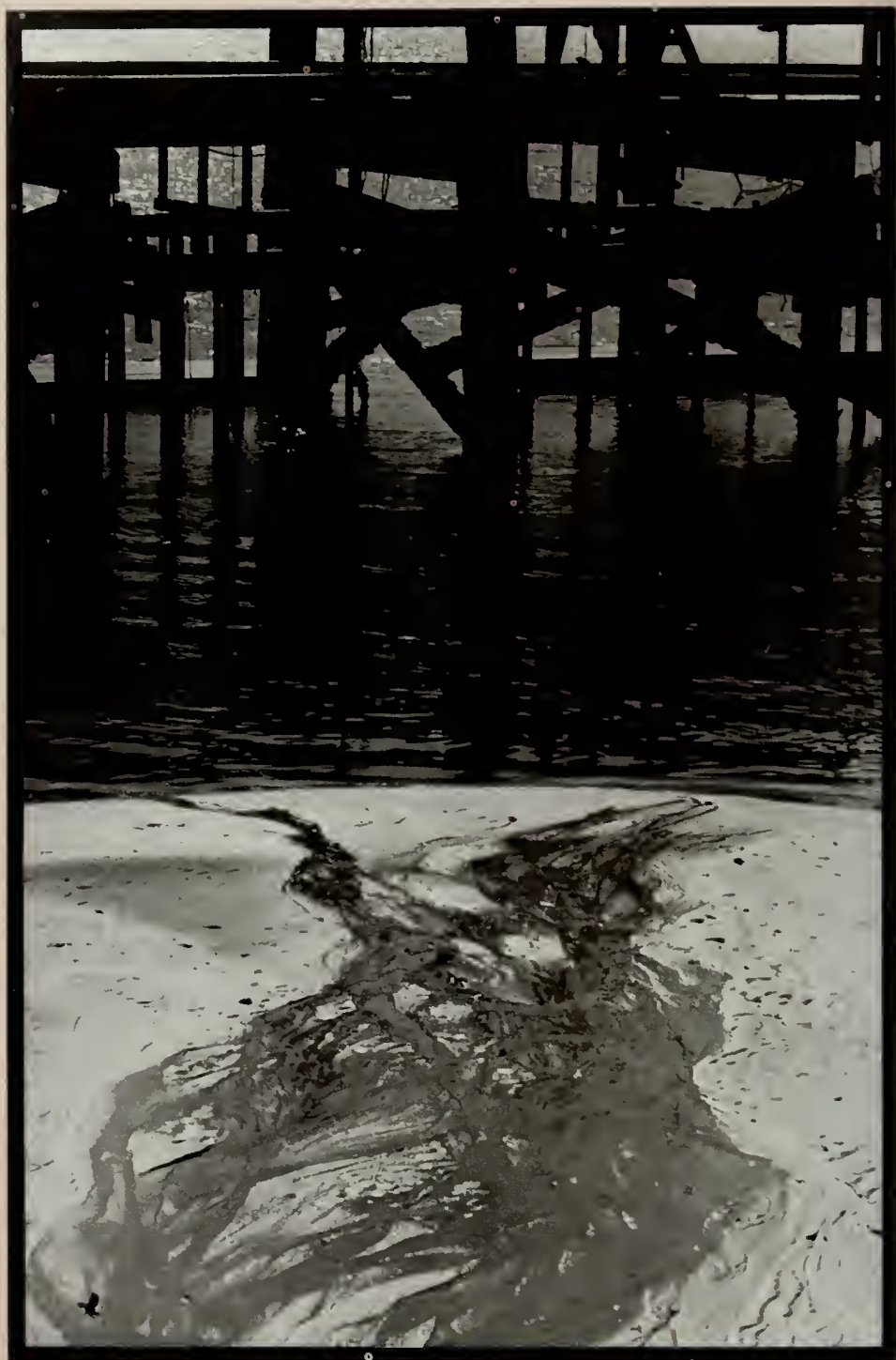
The physical plant consists of twenty-two buildings including five dormitories, a large dining hall, one residence, boathouse, storehouse for ship's gear, classroom laboratories, and six research buildings. The research laboratories and five dormitories are heated, and three dorms are air-conditioned thereby providing favorable conditions for year-round research.

Pivers Island is only 150 yards across the channel from the town of Beaufort. A bridge leads to U. S. Highway 70, so that the island is readily accessible by automobile. Transportation to the Laboratory consists of: bus service to Beaufort, Wheeler Airline service to Beaufort, and Piedmont Airlines in New Bern, forty miles from Beaufort.

The Beaufort area is well known for its moderate climate during the summer. Air temperatures range from an average minimum of 70°F. to an average maximum of 86°F. There is a prevailing southwest breeze from the ocean during most of the summer. Water temperatures range from 22-29°C. in June and from 24-30°C. during August.

Students should bring clothes suitable for field work including a sun hat, tennis shoes, bathing suit, shorts, work gloves, and sunglasses.

There are ample opportunities for recreation in and around Beaufort for swimming, fishing, boating, and water-skiing. On campus there are recreational facilities for swimming, diving, shuffleboard, horseshoe pitching, volleyball, croquet, and table tennis.



## Resources for Study





## Flora and Fauna

Beaufort is approximately midway between Woods Hole, Massachusetts, and Miami, Florida, in an area within the range of both the northern and southern species of biota. The edge of the Gulf Stream system is about thirty-five miles offshore, and between it and the shore occasional reefs are found.

The Beaufort area is strategically located for biological research because of the richness of its flora and fauna, and the ease with which one may reach many diverse habitats. From the Laboratory, by boat or automobile, the ocean, Cape Lookout and the Outer Banks, Bogue and Core Sounds, Harkers Island, rivers, creeks, canals, mud flats, sand beaches, dunes, marshes, peat bogs, cypress swamps, bird islands and rookeries, and coastal forests are readily accessible. Long leaf pine, yaupon, and at least seven species of insectivorous plants (protected by law), including the Venus flytrap, grow in the region. A great variety of algae, both fresh water and marine, is also available for study. Common animals include the king crab, squid, shrimps, snails, clams, ctenophores, jellyfish, hydroids, sponges, polychaetes, sea urchins, starfish, brittle stars, sand dollars, skimmers, terns, gulls, herons, sea turtles, porpoises, and many different types of fish.

## Research Interests

Much of the early research at the Marine Laboratory consisted of determining the distribution of plants and animals within the varying environments of the Beaufort estuary. With the addition of the Cooperative Oceanographic Program and the expansion of year-round activities, the general theme of the relationships of animals and plants to their environment has been broadened to include all segments of the estuarine and oceanic environments. Year-round research by resident staff, associates, visiting staff, and graduate students generally falls into five broad disciplines: biochemistry, developmental biology, oceanography, physiology, and systematics-ecology.

**Biochemistry.** The primary emphasis in the biochemical studies involves research on the structure, function, and evolution of protein molecules. Proteins, especially those involved in the transport of molecular oxygen (hemoglobin, hemocyanin, chlorocruorin, and hemerythrin), are being isolated and their structural and functional properties elucidated. These studies are intended to illustrate how molecules have evolved and how they are involved in adaptive processes. From comparative studies one can illuminate structure-function relationships and derive data of phylogenetic significance. Studies of protein polymorphisms are also intended to illustrate gene flow among populations and offer insights into the adaptive strategies of marine organisms.

**Developmental Biology.** Much of the research in developmental biology deals with the culture of invertebrate larvae under controlled conditions in the

laboratory, from hatching until the juvenile stages are reached. The availability of numerous larvae of known species, age, and stage of development has led to studies on the extent to which environmental factors within the marine environment affect rates of development, survival, and morphological abnormalities. In addition to studying the effects of natural environmental factors, research is under way to determine the effects of pollutants on larval development of marine Crustacea. The developmental biology program also includes studies on the physiology of crustacean larvae and the factors involved in regulation of molting, rate of development, and metamorphosis during larval development.

**Oceanography.** Within the Oceanography Program, research is being conducted to examine the physical and biological dynamics of marine ecosystems which are enriched by upwelling, including the Coastal Upwelling Ecosystems Analysis Program, a multi-university and multi-ship field experiment concentration on the northwest African coast upwelling. Other interests include the effect of metal and dissolved organic interactions on the biological productivity of the upwelling system and the measurement and modeling of carbon productivity of the ecosystems. Research is also under way on the rate of recycling of sewage sludge and the impact of sewage disposal on marine systems, the chemical form and biological reactivity of toxic and essential metals as determined by electron paramagnetic resonance, the ability of phytoplankton to synthesize coordination compounds that form complexes with metals and alter their biological reactivity, and the isolation and identification of hydroxamic acids suspected of being responsible for the biogenic conditioning of seawater.

Geological investigations are primarily concerned with processes of continental margin sedimentation, largely within the Carolina continental shelf slope and rise, and also in certain deep basins in the vicinity of the Bahama Banks. Studies are concerned with the origin of postdeath shell coloration and the sediment distribution and sedimentary processes on the Cape Hatteras sediment plume, characterization of the continental rise and the relative importance of bottom currents versus gravity flows in forming the rise, and delineation of individual sorting effects. Additional research involves sea floor topography, including contouring and diagramming continental and insular margins with emphasis on the distribution and patterns of submarine canyons. Geomorphologic studies are also under way in support of investigations in the Caribbean.

**Physiology.** In the realm of physiological studies, one primary interest involves studies on the photobiology of organisms in the marine environment, with emphasis on behavioral orientation to light. This involves determining the responses of a variety of marine organisms (unicellular dinoflagellates, larval crustaceans, and fish) to light, both in the natural environment as well as in the laboratory. Primary attention is on the identification of the light receptive pigments participating in the responses and the circadian rhythm of these responses. Accordingly phototaxis is used as a model system for studying the basic physiology of rhythms.

A second primary interest is in the mechanisms of ionic and osmotic regulation in marine plants and animals. Euryhaline organisms can survive drastic fluctuations in salinity, and the internal adjustments made by these organisms may involve large changes in concentrations of amino acids and inorganic ions. One of our primary goals is to elucidate the metabolic processes which are responsible for these regulatory changes. Some marine organisms possess giant cells which offer unique opportunities for studying membrane transport processes. By internally perfusing these cells by means of micropipets we can control the internal ionic composition, hydrostatic pressure, and transmembrane voltage and current. At the same time we can measure the rates of solute and

water movements across the cell surface, thus gaining insight into the mechanisms and functions of the transport processes.

**Systematics-Ecology.** Research in the Systematics-Ecology Program involves studies on community structure, benthic algae, and distribution of certain marine species off the North Carolina coast, and experimental phycology and phytoplankton systematics.

The major objective of studies on community structure is to identify and understand the processes which result in the temporal and spatial patterns in species abundance in some subtidal, epibenthic communities. Changes in the adult populations are followed with mapping and photographic techniques. The approach is experimental to the extent that species can be removed or excluded from the community to assess their importance in community structure and function. An eventual goal is the development of a systems model incorporating the basic community processes to provide the basis for predicting the deliberate or accidental effects of man's perturbations of these communities.

In part because the middle Atlantic coast is a meeting ground for the cool water species typical of northern shores and the warm water species of the Caribbean, studies include the determination of the distribution, phenology, and systematics of benthic algae off the coast of North Carolina. This work includes efforts to determine community structure and productivity in the different portions of Onslow Bay and to extend the studies north and south along the entire coast. A second aspect of the work is a descriptive study of the epiphytic algae which grow in the sounds on the blades of eelgrass and other marine angiosperms. In experimental phycology and phytoplankton systematics, the program of research comprises several related major areas particularly concerned with the biology of the algal class Haptophyceae (coccolithophorids and others). Experimentally oriented systematics investigations of marine phytoplankton are concerned primarily with life cycles and morphological variation. Ultrastructural and physiological research emphasizes the intracellular deposition of calcium carbonate into coccoliths—their formation, regulation, and relationships to other cellular processes. Another line of physiological and biological oceanographic research is concerned with growth and calcification of phytoplankton in very dim light and darkness in an attempt to elucidate naturally occurring deep-sea populations.

Additional studies are being conducted to investigate the growth rates and development of suspension feeders in relation to temperature, size of the animals, concentration of suspended material, and the relative concentration of phytoplankton in suspension. These experiments involve natural seawater in a continuous flow system in which the concentration of phytoplankton can be monitored. The data should determine the conditions under which maximum energy transfer occurs between primary producers and a primary consumer, facilitating the future exploitation of scallops, oysters, and other similar species.

## Research Facilities

**Laboratory Equipment and Supplies.** Visiting investigators may obtain research space throughout the year. Each research laboratory building is air-conditioned and equipped with running seawater through a hard rubber system. There are tanks, water tables, aquaria, autoclaves, ovens, and plant presses. In addition to commonly used laboratory equipment, the following are available: two refrigerated centrifuges with multi-speed attachments, Beckman DU spectrophotometer, balances, pH meters, hoods, and constant temperature equipment. Each person is expected to supply his own optical equipment or



other special apparatus needed. A list of equipment, chemicals, and glassware may be obtained upon request. The Laboratory also maintains a darkroom and well-equipped workshop.

**Research Facility.** A three-story modern research laboratory was completed early in the summer of 1972. Each room is well lighted artificially and all exterior rooms also receive natural light. Most rooms have a view of the water surrounding some part of Pivers Island. All rooms are air-conditioned and heated electrically so that the temperature of each room can be controlled to suit the needs of the occupant. Hot and cold water, air, gas, and vacuum are available in most rooms. The non-metallic seawater system is especially designed to reduce silt and fouling. The general arrangement of rooms on each floor provides for a core of rooms in the center of the building which are for general use and research rooms of different sizes are at the periphery of the building. Although the rooms on all three floors were designed for special purposes, they may be used for research in a variety of disciplines.





**Oceanographic Study.** The 117.5-foot research vessel *Eastward* with a capacity for forty students on eight-hour cruises or fourteen students and staff on extended cruises may be used for oceanographic research. During the present year, the ship will operate in the Atlantic Ridge, the Caribbean Sea and the Peruvian coast. It is outfitted with modern recording and collecting devices and is available to investigators and teachers of graduate courses in marine sciences and their students. Application for ship time must be made in advance. Inquiries should be addressed to the Oceanographic Program Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

**Collecting.** Spades, shovels, sieves, and nets are provided without charge to assist the investigator with his collecting. A wide assortment of boats is available for various collecting activities. A complete schedule of boats and charges may be found in the section on financial information. Information on species availability and collecting sites is available from the Curator of the Reference Collection.

**I. E. Gray Library-Auditorium.** This facility is air-conditioned, electrically heated, and has stack space for 18,500 volumes on the first floor. A second floor is intended for future expansion. Located in the building are the librarian's office, a room for duplicating machines, a receiving room, a kitchenette, two seminar rooms, and two closed carrels.

The building houses the Pearse Memorial Library which contains 4,250 catalogued reference books and journals, 150 current journals, and 1,720 reprints. There are also expedition reports in oceanography, a microfilm library of graduate student theses based on research at the Laboratory, a microfilm reader, and an A.B. Dick copier. Other materials may be obtained by a special delivery system from the Perkins Library on the Durham Campus or through the inter-library loan service with other libraries in the United States.

The auditorium has a seating capacity of approximately 300 and is suitable for lectures, seminars, symposia, and small regional or national meetings.

**Reference Collections.** A reference collection of approximately 1,500 different species of animals from coastal North Carolina is available to students and research personnel. Small collections of marine algae and vascular flora are also maintained, as well as a checklist by habitat of the common marine animals.

**Computing Facilities.** A PDP 11/10 digital computer with RK-11 Disk and TA11 Dual Cassette is available for general student and staff use. It has an 16-K core memory bank and uses BASIC, a conventional, on-line language similar to FORTRAN. The input-output devices are an LA30 DEC writer and a 4012 Tektronix Display Terminal.

**Electron Microscope.** The electron microscope laboratory comprises a microscope room housing an RCA EMU-3F transmission electron microscope, a photographic darkroom, a sectioning room housing a Porter Blum MT2-B ultramicrotome and light microscopes, and a preparation room with fume hood, vacuum evaporator, etc. The facility is available to qualified users; however, requests for microscope time must be made in advance. Address inquiries to: Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.



## Financial Information



## Tuition

**Summer Terms.** The following are tuition charges for summer registration and medical care:

1. Undergraduate students: \$258.00 for each nonlaboratory course; \$344.00 for each undergraduate laboratory course; and \$516.00 for each one and one-half course (6 unit) program offered at the Duke University Marine Laboratory.
2. Graduate students: \$96.00 per unit; and for an undergraduate course, the tuition rate indicated in section 1 above is applicable.
3. Full-time teachers in elementary and secondary schools: one-half of the tuition charge specified in sections 1 and 2 above is applicable.

The Director of the Summer Session will notify the applicant of course approval. Tuition should then be paid promptly to the Business Office, Duke University Marine Laboratory, Beaufort, North Carolina 28516, to assure a reservation in a class. Tuition payment should be made ten days prior to the first day of class.

## Refunds

**Refund for Tuition and Fees.** Tuition and fees will be refunded under the following circumstances:

1. When applications for withdrawal are received by the Director of the Summer Session before the first class day of a given term of the summer session, full tuition and fees will be refunded.
2. When applications for withdrawal are received by the Director of the Summer Session during the first four class days of a given term, 80 percent of the tuition and fees will be refunded.
3. When applications for withdrawal are received by the Director of the Summer Session after the fourth class day, there will be no refund of tuition and fees.

## Research Space

Individual research cubicles varying from 80 to 400 square feet are available at the Duke University Marine Laboratory. The rental fee for research space is \$1 per square foot per month from May 1, 1976 to April 30, 1977.

No additional charges are made for research assistants occupying the same research space as the investigators. Laboratory space rental does not apply to students participating in any Duke University Marine Laboratory courses.

Inquiries and requests for space should be addressed to the Business Manager, Duke University Marine Laboratory, Beaufort, North Carolina 28516. Applications for the academic year are encouraged and will be acted upon shortly after they are received. All research applications for the summer of 1976 must be received by March 10, 1976.



## Living Accommodations\*

**Dormitories.** Air-conditioned and a few non-air-conditioned dormitory rooms are available. Although every effort is made to have only two people per dormitory room, a few triple rooms may be needed to accommodate all individuals requiring dormitory space. Prospective students should indicate their preference for housing on the application for enrollment. It is impossible to guarantee that these preferences will be available in all cases.

Occupants must supply their own linens, blankets, and towels, but pillows will be furnished. All dormitory occupants will be on the board system during the spring semester and summer terms. A key deposit of \$1 will be charged each person occupying a dormitory room. This deposit will be refunded at time of departure.

Dormitory charges which are payable at the Business Office of the Laboratory upon arrival are as follows:

### Summer 1976

Non-air-conditioned double	\$80 per term for each occupant
Air-conditioned double	\$90 and \$100 per term for each occupant

### Spring 1977

Air-conditioned double	\$270 and \$300 per semester for each occupant
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Double rooms for married students are usually supplied only if both husband and wife are registered students at the Laboratory.

**Beaufort Housing.** Because Beaufort is located in a resort area, off-campus housing is very difficult to obtain and costs may range from \$20 to \$50 per week per person. Housing in the Morehead City-Beaufort area is limited for married couples who are not both registered students at the Laboratory and couples with children. A list of area realtors will be mailed to students upon request.



# Dining Facilities\*

The Duke University Marine Laboratory dining hall will be open during spring semester and first, second, and third summer sessions. All dormitory residents are required to pay the full board fee of \$170 per summer term. Students residing off-campus may purchase a full board meal ticket, weekly meal ticket, or individual meals. Individual meals are the most expensive on a meal-by-meal basis. Individual meal rates are as follows:

Breakfast	\$1.30
Lunch	2.00
Dinner	2.50
Sunday Dinner	3.00

Children under twelve years of age will be charged one-half the adult rate.

The full board fee provides for three meals per day, Monday through Saturday, and breakfast and noon dinner on Sunday. No credit will be allowed for meals that are missed, including those meals which may be missed as a result of research cruises in conjunction with course work. Meals will usually be provided on these cruises.

Research personnel and their families residing off-campus are urged to eat in the dining hall. Arrangements may be made for occasional meals if sufficient notice is given to the Dining Hall personnel.

The board fee is payable in full on or before the day of registration at the Business Office of the Laboratory.

\*All dining hall and dormitory rates are subject to change without notice. Board fee for spring semester has not been determined.

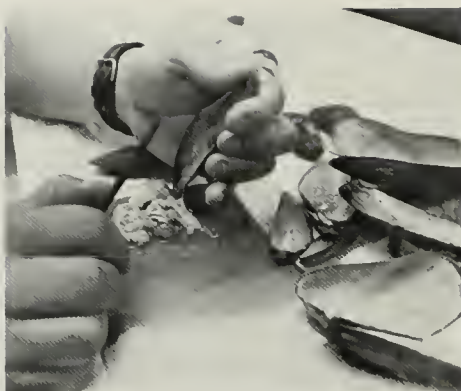
# Boat Rentals

The following boats are available at the Laboratory for collecting and instructional activities:

Boat Type	Name	Charges
55 ft. trawler	Beveridge*	\$26.00 per hour \$208.00 per day
39 ft. cabin diesel powered	Venus*	\$18.00 per hour \$144.00 per day
17.5 ft. speedboat	Thunderbird	\$14.00 per hour \$112.00 per day
22.1 ft. open boat	Ocypode	\$14.00 per hour \$112.00 per day
Boston Whaler		\$6.00 per hour \$48.00 per day
Skiffs with outboard motors		\$3.50 per hour \$25.00 per day

\*Crew required for safety of user and vessel.

These rates are intended to partially defray the cost of operating and maintaining these boats.



Most of these boats may be scheduled by visiting researchers through the Maintenance Office; however, first priority must be given to classes when they are in session during the spring and summer terms.

If crew overtime is involved before or after their normal work day and any time Saturday or Sunday, the following charges will be made from July 1, 1976, to June 30, 1977; Master, \$5.85 per hour; Winch Operator, \$5.00 per hour; additional charge for overtime on Duke University holidays, \$3.00 per hour.

## Other Financial Information

**Check Cashing.** The banks in the Morehead City-Beaufort area have indicated that they will not cash personal checks for students unless they are guaranteed. Therefore, it is recommended that students at the Laboratory bring with them sufficient traveler's checks, money orders, certified checks, or cash to cover expenses.

**Other Fees.** Late registration fees will be charged in accordance with Duke University policy unless registration is completed and all fees paid by the last day of registration for the term.



**Debts.** No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

## Teaching Assistantships

Five graduate student teaching assistantships are available during the period from January 1 through August 31 of each year. Students registered in a graduate program in any department in the sciences at Duke University may apply. Recipients must be in residence at Beaufort during the period of their appointment and also conduct, or plan to conduct, their research at the Duke University Marine Laboratory in Beaufort.

Applications must be received by the Director of Graduate Student Affairs before October 1. Applicants will be judged on the basis of need, qualifications for the courses in which they will assist, and previous teaching and graduate experience. A student may receive a maximum of three years' support under this program.

For further information, write the Director of Graduate Student Affairs, Duke University Marine Laboratory, Beaufort, North Carolina 28516.





## Admissions





## Requirements and Procedures

All students applying to the Duke Marine Laboratory should complete the appropriate application form at the back of this *Bulletin* and submit a transcript of their grades. Applicants will be considered without regard to race, color, religion, sex, or national origin. Students desiring a transfer of credit to their home institutions should request a course approval form for transfer of credit from the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516.

**Summer Terms.** All courses offered at the Laboratory during the summer are intended for graduate students and senior undergraduate students. Applications should be submitted to the Director of the Duke University Marine Laboratory as early as possible and not later than March 10. Late applicants will be admitted if space permits. After acceptance, payment of tuition is essential to assure reservation in a course.

Students wishing to apply summer credits toward an advanced degree at Duke University must, in addition to filling in the application blank, register with the Duke University Graduate School. Students who have had adequate preparation and approval of their major professor may request space for independent or thesis research.

Students should plan to arrive no sooner than Monday, May 10 for Term I; Sunday, June 13 for Term II; and Sunday, July 15 for Term III. All students, except those enrolled in the following term, should vacate dorm rooms on the last day of the term.

For schedule of concurrent summer courses taught at the University of North Carolina Institute of Marine Sciences in Morehead City, N. C., write: Director, Marine Sciences Program, University of North Carolina, 12-5 Venable Hall, Chapel Hill, N. C. 27514.

**Spring Semester.** An interdisciplinary program in the marine sciences is offered at the Duke Marine Laboratory for the spring semester. The program is open to qualified juniors and seniors from Duke and other colleges and universities. The full semester program for each student consists of two courses, one or two seminars, and independent study. Applications are to be submitted by October 7 to the Director of the Duke University Marine Laboratory. Each applicant should request two letters of recommendation, one of which must be from the director of undergraduate studies, or the equivalent, from the student's major department. Students will be notified of the action of the Admission Committee prior to registration for the spring semester.

Duke University students are given preference in admission if judged equal to other applicants in academic preparation and general potential for making maximum use of the opportunities afforded by residence at the Laboratory. (The application form is in the back of this *Bulletin*.)



## Courses of Instruction



## FIRST SUMMER TERM

**Introduction to Biological Oceanography.** (Zoology 114L.) Physical, chemical, and biological processes that characterize the oceans, emphasizing special adaptations of organisms for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: college biology. One and one-half courses (6 graduate units). *Cox* (Visiting Summer Faculty)

## SECOND SUMMER TERM

**Independent Study.** (Botany, Geology, or Zoology 192T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

**Marine Ecology.** (Zoology 203L.) The application of ecological theory to marine systems. The mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current literature. Prerequisites: a course in general zoology or invertebrate zoology and calculus. Knowledge of statistics helpful. One and one-half courses (6 graduate units). *Staff*

**Invertebrate Embryology.** (Zoology 278.) Lectures, readings, and laboratory work dealing with rearing, development, and life history of invertebrates. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *Bookhout*

**Phytoplankton Systematics.** (Botany 202.) Introduction to taxonomy and the classification of marine phytoplankton: their general characteristics, phytoecology, life histories, and techniques for preservation, preparation, and enumeration of phytoplankton samples. Individually arranged advanced work in selected areas. One and one-half courses (6 graduate units). *Blankley*

**Physiological Ecology of Marine Animals.** (Zoology 250.) A study of the physiology of marine and estuarine animals in relation to certain environmental factors (temperature, salinity, oxygen, and light). Animals representing numerous phyla from various habitats are studied. Prerequisite: a course in physiology and general zoology. One and one-half courses (6 graduate units). *Forward*

**Chemical Oceanography.** (Chemistry 240.) Distribution, alteration, and transport of chemical species in the marine environment. R/V *Eastward* cruise to gather samples for evaluating chemical processes in the ocean. Prerequisite: Permission of instructor. A knowledge of physical chemistry is desirable. Includes lectures, laboratory work, and field trips. One and one-half courses (6 graduate units). *Baier*



**Marine Phycology.** (Botany 211.) An introduction to marine algae—their identification, taxonomy, morphology, physiology, and ecology. Field trips are complemented by laboratory study, culturing, and preparation of herbarium material. One and one-half courses (6 graduate units). *Searles*

**Marine Electrobiolgy.** (Biomedical Engineering 252.) This course deals with the physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the inter-animal communication level. Particular emphasis is placed on electrophysiological studies of marine organisms (vertebrate and invertebrate) wherein cellular correlates of animal behavior are clearly seen. Topics include: the ionic basis of bioelectric signals, the transmission of signals within and between excitable cells (nerve and muscle), the translation of neural signals into behavior patterns, the effects of externally applied electric fields on behavior (e.g., electroreception in fish), bioelectric “navigation” (in fish), and technical applications (such as electrofishing). One and one-half courses (6 graduate units). *Wachtel and Wolbarsht*

**Research.** (Zoology 354.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory required. (For graduate students only.) *Staff*





### THIRD SUMMER TERM

**Independent Study.** (Botany, Geology, or Zoology 191T.) For senior and junior majors with permission of the appropriate director of undergraduate studies and the supervising instructor. Course credit to be arranged. *Staff*

**Marine Invertebrate Zoology.** (Zoology 274.) A study of invertebrate animals that occur in the Beaufort region. A number of field trips will be made to a variety of habitats to study and to collect animals in their natural environment. The structure and habits of living invertebrates, as well as their behavior under experimental conditions, will be studied in the laboratory. (Zoology 274 is not intended for students who have had a graduate course in invertebrate zoology.) Prerequisite: a course in general zoology or general biology. One and one-half courses (6 graduate units). *Barnes*

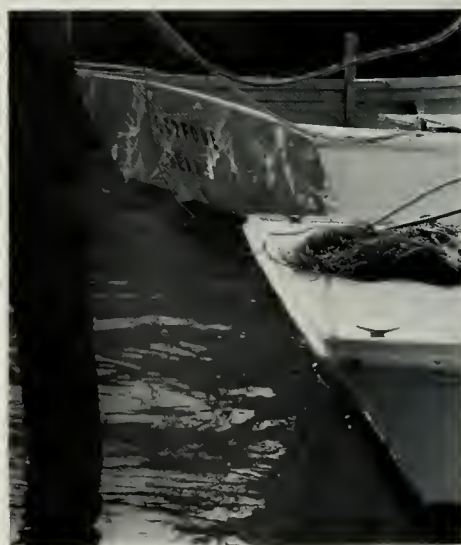
**Environmental Oceanography.** (Chemistry 230.) Examination of chemical, biological, and geological aspects of pollution in the marine environment. The interaction of man with natural marine processes on shore lines and shelves. Application of marine science to compatible utilization of marine resources. Prerequisite: Permission of instructor. A knowledge of physical chemistry is desirable. One and one-half courses (6 graduate units). *Baier and Staff*

**Marine Microbiology.** (Botany 204.) The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton—their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. One and one-half courses (6 graduate units). *Staff*

**Geological Oceanography.** (Geology 205.) The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water (the course is not open to students who have completed Geology 206). One and one-half courses (6 graduate units). *Pilkey*

**Comparative and Evolutionary Biochemistry.** (Biochemistry 276.) Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation, electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. One and one-half courses (6 graduate units). *Sullivan*

**Biological Oceanography.** (Zoology 214.) The special adaptations of organisms for life in the sea and the impact of biological processes on the non-living components of the marine environment provide the core of the biological oceanography course. Among the ideas emphasized are the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in regulating the abundance, distribution, and community organization of marine organisms. A cruise on the R/V *Eastward* will investigate the physical and chemical processes which support the biological productivity of the continental shelf ecosystem. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). *Barber*



**Membrane Physiology and Osmoregulation.** (Physiology 212.) Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. The course also includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in plants and animals.

Laboratory work deals with membrane transport processes in single cells and epithelia, electrophysiology and synaptic transmission in mollusks, renal and gill transport processes in fish, amino acid transport and metabolism in crustaceans, and the application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: permission of instructor. One and one-half courses (6 graduate units). (Not given summer 1976.) *Gutknecht*

**Research.** (Zoology 353.) Hours to be arranged. Prior approval of instructor at the Duke University Marine Laboratory is required. (For graduate students only.) *Staff*

## Spring Semester—Undergraduate Program

The semester program consists of the courses listed below. A student may apply during the spring to continue study at the Marine Laboratory during the summer either by participating in senior-graduate courses or by continuing the independent studies initiated during the spring term.

**Man and the Marine Environment.** (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the extent to which modern society has affected the marine environment, with special emphasis on problems of coastal North Carolina. Lectures and laboratories. Prerequisite: consent of instructor and director of undergraduate studies of student's major department. One course. *Costlow and Staff*

**Adaptations of Organisms to the Marine Environment.** (Biochemistry 220.) An introduction to basic concepts of biochemistry and to variables in the marine environment which evoke adaptive responses. Specific adaptations at the molecular level are considered and the general topic of biological fitness is discussed from a biochemical viewpoint. Laboratory experiments utilize many basic methods of biochemical analysis. The course is designed to stimulate interest in the molecular basis of adaptation and to give participants greater insight into the unsolved problems in this area. Prerequisites: basic biology and chemistry and consent of instructors. One course. *C. Bonaventura and J. Bonaventura*

**The Marine Environment.** (Botany, Geology, or Zoology 169.) The interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisite: introductory chemistry and consent of instructor and the appropriate director of undergraduate studies. One course. *Staff*

**Physiology of Marine Organisms.** (Zoology 150L.) Comparative physiology of marine animals including special ecological and behavioral adaptations. Lectures and laboratories. A student may not receive credit for both Zoology 150L and 250L. Prerequisite: introductory biology and chemistry; consent of instructor and director of undergraduate studies of student's major department. One course. *Forward*

**Seminar.** (Biochemistry 296S.) Recent research in the biochemistry and genetics of marine organisms: enzymes, evolution and ecological strategies. Half-course. *Sullivan*. (Botany 225S.) Current topics in coastal and marine botany. Half-course. *Blankley*. (Zoology 296S.) Man's impact on biogeochemical cycles. Half-course. *Barber and Baier*

**Independent Study.** (Botany, Geology, or Zoology 192.) For senior and junior majors with permission of the director of undergraduate studies and the supervising instructor. One and one-half courses. *Staff*





## Seminars





## Academic Year 1974-1975

Date	Speaker	Topic
Nov. 20	Mr. Kjell Baalsrud Director of Norwegian Institute for Water Research Oslo, Norway	Dynamics of the Oslo Fjord and the Consequences of Water Pollution
Jan. 27	Mr. James Willis National Marine Fisheries Lab Beaufort, North Carolina	The Newport River - An Environmental Problem
Feb. 14	Mr. James Brown Dept. of Natural and Economic Resources State of North Carolina Morehead City, North Carolina	Problems of Landfill in the Coastal Environment
Feb. 28	Dr. Donald Hoss, Supervisor Lower Neuse Soil Conservation District Beaufort, North Carolina	Effects of Stream Channelization and Mosquito Control Ditching on Tidal Marshes
March 5	Dr. Austen Riggs Department of Zoology University of Texas Austin, Texas	Tadpole Hemoglobins
March 7	Mr. William Davis Environmental Protection Agency Washington, D.C.	The Environmental Protection Agency
March 24	Dr. Paul Godfrey Department of Botany University of Massachusetts Amherst, Massachusetts	Ecological Consequences of Barrier Island Migration
April 2	Dr. Charles E. Epifanio College of Marine Sciences University of Delaware Newark, Delaware	Aquaculture

April 4	Dr. E. L. Bousfield Senior Scientist National Museum of Natural Sciences Ottawa, Canada	Post-glacial Dispersal of Littoral Marine Invertebrates of the North American Atlantic Region
April 8	Dr. K. A. Pirozynski Biosystematic Research Institute Ottawa, Canada	Fossil Fungi and the Role of Fungi in Evolution of Terrestrial Plants
May 6	Dr. Paul K. Dayton Scripps Institute of Oceanography University of California La Jolla, California	Selected Aspects of Nearshore Community Ecology
May 7	Dr. Thomas Duke, Director EPA Pesticide Lab Gulf Breeze, Florida	Pesticides in the Marine Environment
May 9	Dr. Sidney R. Galler Deputy Assistant Secretary for Environmental Affairs U. S. Department of Commerce Washington, D. C.	Environmental Protection, Economic Well-being, and the Availability of Energy Fuels: The Tripod Supporting Modern Civilization
May 16	Dr. Berry Pinshow Department of Zoology Duke University Durham, North Carolina	Thermoregulation and Cost of Locomotion in Emperor Penguins
May 16	Dr. Robert W. Noble Department of Biochemistry School of Medicine State University of New York Buffalo, New York	Fish Hemoglobins
May 26	Dr. John J. Magnuson Laboratory of Limnology University of Wisconsin Madison, Wisconsin	Oceanic Populations of Tuna
May 28	Dr. Ruth D. Turner Museum of Comparative Zoology Harvard University Cambridge, Massachusetts	Bivalve Larvae - Behavior, Distribution and Identification
May 29	Dr. George A. Knox Department of Zoology University of Canterbury Christchurch 1, New Zealand	The Impact of Man on a New Zealand Estuary
June 2	Dr. Norman Christensen Department of Botany Duke University Durham, North Carolina	The Role of Disturbance in the Stability of Plant Communities



- |         |   |  |
|---------|---|--|
| June 17 | Dr. Jorge Petersen<br>Universidade de Sao Paulo<br>Instituto de Biociencias<br>Cidade Universitaria<br>Caixa Postal 11.230-01000<br>Sao Paulo, Brazil | Eco-Physiological Studies on<br>Echinoderms and Tunicates              |
| June 19 | Dr. Ray Seed<br>Department of Zoology<br>Queen's University<br>Belfast, Northern Ireland  | Population Structure in Three<br>Species of Marine Bivalve<br>Molluscs |
| June 24 | Dr. David Hastings<br>Department of Physiology<br>Duke University<br>Durham, North Carolina   | Ion Transport and Regulation<br>of Turgor Pressure in a<br>Marine Alga |
| June 26 | Dr. J. Douglas Glaeser<br>Department of Earth and Planetary<br>Science<br>City College of the City University<br>of New York<br>New York, New York    | Dynamics and Sediment<br>Budget of Barrier Island<br>Systems           |
| July 1  | Dr. Orrin Pilkey<br>Department of Geology<br>Duke University<br>Durham, North Carolina  | Shoreline Problems in<br>Coastal North Carolina                        |

July 3	Dr. Ponce Bonnefil, Director Pesticides Program Department of Natural Resources Box 5887 Puerto de Tierra, Puerto Rico	Pesticides in Central America and the Caribbean Area
July 8	Dr. Joseph Bonaventura Department of Biochemistry Duke University Medical Center Durham, North Carolina	Structure and Function of Arthropod and Molluscan Hemocyanins
July 10	Dr. Ron Karlson Department of Zoology Duke University Durham, North Carolina	Predation and Community Structure - a Field Study
July 15	Mr. James Thorp National Marine Fisheries Service, NOAA Beaufort, North Carolina	Interference Competition as a Mechanism of Coexistence Among Sympatric Grass Shrimp
July 17	Dr. Chris Martens Marine Sciences Program University of North Carolina Chapel Hill, North Carolina	Dissolved Gasses and Nutrient Regeneration in Anoxic Marine Sediments





July 22	Ms. Sharon Smith Department of Zoology Duke University Durham, North Carolina	The Role of Zooplankton in the Nitrogen Dynamics of Marine Systems
July 24	Prof. F.J.R. Hird Department of Biochemistry Gatty Marine Laboratory University of St. Andrews* St. Andrews, Scotland	Investigations on the Evolutionary Origin of the Biochemical Functions of the Liver
July 26	Prof. Pierre Drach Department of Marine Biology University of Paris Paris, France	Locomotory and Feeding Behavior of Coral Reef Fishes
July 31	Dr. Richard Searles Department of Botany Duke University Durham, North Carolina	Studies of Continental Shelf Algae
Aug. 5	Dr. C. R. Boyden Applied Geochemistry Research Group Department of Geology Royal School of Mines Imperial College of Science and Technology London, England	Metals and Shellfisheries of the United Kingdom
Aug. 7	Dr. Donald Hoss National Marine Fisheries Service NOAA Beaufort, North Carolina	Effects of Increased Temperature and Chlorine on Survival and Metabolism of Larval Fish
Aug. 12	Dr. Ralph Cavaliere Department of Biology Gettysburg College Gettysburg, Pennsylvania	Fungi Grow in the Damndest Places
Aug. 14	Dr. Frank Schatzlein Department of Biology California State University Long Beach, California	The Regulation of Glycolysis in Crab Tissues
Aug. 19	Dr. Len Kirschner Zoology Department Washington State University Pullman, Washington	Kidney Function in Marine Teleosts

\*On sabbatical from Australia.



## Publications



## Publications 1974-1975

- Barber, Richard T. 1974. The relationship between circulation and productivity in upwelling ecosystems. *Tethys* 6(1-2):319.
- ; P. J. Whaling; and D. M. Cohen. 1975. Factors affecting mercury concentrations in recent and old bathyl-demersal fish. *Environ. Health Perspectives* (In Press.)
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- Bisson, Mary A., and John Gutknecht. 1975. Osmotic regulation in the marine alga, *Codium decorticatum*. I. Regulation of turgor pressure by control of ionic composition. *J. Membrane Biol.* (In Press.)
- Bonaventura, Celia; B. Sullivan; J. Bonaventura; and S. Bourne. 1974. CO Binding of hemocyanins of *Limulus polyphemus*, *Busycon carica*, and *Callinectes sapidus*. *Biochemistry* 13(23):4784-4789.
- ; B. Sullivan; and J. Bonaventura. 1974. The effect of anions and pH on the functional properties of hemoglobins from *Lemur fulvus fulvus*. *J. Biol. Chem.* 249:3768-3775.
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- Bonaventura, Joseph; C. Bonaventura; and B. Sullivan. 1974. Hemoglobin of the electric Atlantic torpedo, *Torpedo nobiliana*: a cooperative hemoglobin without Bohr effects. *Biochim. Biophys. Acta* 371:147-154.
- ; C. Bonaventura; and B. Sullivan. 1974. Urea tolerance as a molecular adaptation of elasmobranch hemoglobins. *Science* 186:57-59.
- ; C. Bonaventura; M. Brunori; B. Giardina; E. Antonini; F. Bossa; and J. Wyman. 1974. Functional properties of carboxypeptidase-digested hemoglobins. *J. Mol. biol.* 82:499-511.
- ; C. Bonaventura; G. Amiconi; E. Antonini; and M. Brunori. 1974. Functional properties of hemoglobin Leiden ( $\alpha_2\text{A}_{\beta 2}^6$  or  $^7$  Glu deleted). *Arch. Biochem. Biophys.* 161:328-332.
- ; R. G. Gillen; and A. Riggs. 1974. The hemoglobin of the Crossopterygian fish, *Latimeria chalumnae* (Smith)—Subunit structure and oxygen equilibria. *Arch. Biochem. Biophys.* 163:728-734.
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- ; C. Bonaventura; and B. Sullivan. 1975. Hemoglobins and hemocyanins: Comparative aspects of structure and function. *J. Exp. Biol.* (In Press.)



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- Bookhout, C. G., and J. D. Costlow, Jr. 1974. Crab development and effects of pollutants. *Thalassia Yugosl.* (In Press.)
- ; and J. D. Costlow, Jr. 1974. Larval development of *Portunus spinicarpus* reared in the laboratory. *Bull. Mar. Sci. Gulf Carib.* 24(1):20-51.
- ; and J. D. Costlow, Jr. 1975. Effects of mirex on the larval development of blue crab. *Water, Air Soil Pollut.* 4:113-126.
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## Appendix



## CALENDAR FOR SUMMER SESSION

Term I begins—May 11  
Term I ends—June 12  
Term II begins—June 14

Term II ends—July 16  
Term III begins—July 19  
Term III ends—August 20

All students are expected to vacate dorm rooms on last day of term.

## ADMINISTRATION AND LABORATORY PERSONNEL

### Advisory Committee

John D. Costlow, Ph.D., *Director*  
Duke University Marine Laboratory

Donald J. Fluke, Ph.D., *Chairman*  
Department of Zoology

John W. Gutknecht, Ph.D.  
Department of Physiology and Pharmacology

R. L. Hill, Ph.D., *Chairman*  
Department of Biochemistry

Sigfred L. Linderoth, Jr., M.S.  
Department of Mechanical Engineering

Orrin H. Pilkey, Ph.D.  
Department of Geology

Louis Quin, Ph.D., *Chairman*  
Department of Chemistry

Richard B. Searles, Ph.D.  
Department of Botany

### Academic Staff

Rodger Baier, Ph.D.  
Chemical oceanography

Richard T. Barber, Ph.D.  
Biological oceanography

\*Robert D. Barnes, Ph.D.  
Marine invertebrate zoology

William F. Blankley, Ph.D.  
Phytoplankton systematics and experimental  
phycology

Joseph Bonaventura, Ph.D.  
Protein structure and function

C. G. Bookhout, Ph.D.  
Marine invertebrate embryology and in-  
vertebrate zoology

John D. Costlow, Ph.D.  
Marine invertebrate embryology and experi-  
mental zoology

\*James Cox, Ph.D.  
Biological oceanography

\*Summer only.

†Sabbatical leave, 1976.

Richard B. Forward, Ph.D.  
Physiological ecology of marine animals

Robert M. Goll, Ph.D.  
Distribution of living radiolaria

I. E. Gray, Ph.D., Professor Emeritus  
Marine ecology and entomology

†John Gutknecht, Ph.D.  
Membrane physiology

Richard G. Hartnoll, Ph.D.  
Marine environment

\*Terry W. Johnson, Jr., Ph.D.  
Marine microbiology

William Kirby-Smith, Ph.D.  
Marine ecology

\*Orrin H. Pilkey, Ph.D.  
Geological oceanography

\*Richard B. Searles, Ph.D.  
Marine phycology

J. Bolling Sullivan, Ph.D.  
Comparative and evolutionary biochemistry

John P. Sutherland, Ph.D.  
Marine ecology

†Howard Wachtel, Ph.D.  
Biomedical engineering

Adam Zsolnay, Ph.D.  
Trace organic material in the  
marine environment

#### Administrative Staff

**Director**

John D. Costlow  
Professor of Zoology

**Director of Cooperative Program in Biological  
Oceanography - Coordinator, Coastal  
Upwelling Ecosystems Analysis**

Richard T. Barber  
Associate Professor of Zoology and Botany

**Director of Graduate Student Affairs**

John P. Sutherland  
Associate Professor of Zoology

**Director of Undergraduate Student Affairs**

Rodger W. Baier  
Assistant Professor of Chemistry

**Business Manager**

Michael P. Bradley

**Maintenance Supervisor**

Norris A. Hill

**Housekeeping Supervisor**

Olive C. Godette

**Marine Superintendent of  
Oceanographic Operations**

Eric B. Nelson

**Assistant Marine Superintendent of  
Oceanographic Operations**

Fred Kelly

**Master of R/V EASTWARD**

Ragnvald Sandoy



## Research

Bertil Akesson, Ph.D.  
Department of Zoology  
University of Gothenburg  
Fack, S-400 Gothenburg 33  
Sweden

Visiting Professor

The effect of cyclic temperature on the life cycle of *Dinophilus gyrotilatus* (Archannelida); Speciation in the polychaete genus *Ophryotrocha*; and the life cycle of a thigmotrich ciliate, commensal on *Ophryotrocha labronica*.

Rodger Baier, Ph.D.  
Duke University Marine Laboratory  
Staff  
Trace metal studies in coastal waters.

Richard T. Barber, Ph.D.  
Duke University Marine Laboratory  
Staff  
Coastal upwelling ecosystems analysis; Biogeochemical cycling of organic matter and metals; and Phytoplankton nutrition and organometallic complexes in the sea.

Robert D. Barnes, Ph.D.  
Department of Biology  
Gettysburg College  
Gettysburg, Pennsylvania  
Visiting Professor  
Invertebrate zoology.

William F. Blankley, Ph.D.  
Duke University Marine Laboratory  
Staff  
Experimental phycology: systematics, ultrastructure, and physiology of marine phytoplankton.

Celia Bonaventura, Ph.D.  
Duke University Marine Laboratory  
Research Associate  
Photochemical reactions of protein molecules.

Joseph Bonaventura, Ph.D.  
Duke University Marine Laboratory  
Associate, Department of Biochemistry  
Protein structure and function.

C. G. Bookhout, Ph.D.  
Duke University Marine Laboratory  
Staff  
Effects of controlled environmental factors on the development of estuarine and oceanic Crustacea.

Marit Christiansen, Ph.D.  
University of Oslo  
Oslo, Norway  
Visiting Professor  
Salinity and temperature effects on crab larvae, and effects of the larvicide ZR 515 on the development of crab larvae in various salinities and temperatures.

John D. Costlow, Ph.D.  
Duke University Marine Laboratory  
Staff  
Effects of controlled environmental factors on the development and distribution of estuarine and oceanic Crustacea; the effect of cyclic temperature on larvae of marine invertebrates; and studies on molting and growth in larval and adult barnacles and larval decapods.

Richard B. Forward, Ph.D.  
Duke University Marine Laboratory  
Staff  
Investigations of the photobiology of dinoflagellates and larval crustaceans.

Robert M. Goll, Ph.D.  
Duke University Marine Laboratory  
Research Scientist  
Biostratigraphy of radiolaria.

I. E. Gray, Ph.D.  
Professor Emeritus  
Duke University Marine Laboratory  
Director, Reference Museum  
Preparation of atlas of marine benthic organisms.

John Gutknecht, Ph.D.  
Duke University Marine Laboratory  
Staff  
Membrane physiology; permeability and transport properties of marine algae and phospholipid bilayer membranes.

Richard G. Hartnoll, Ph.D.  
Department of Marine Biology  
University of Liverpool  
Port Erin





Isle of Man  
United Kingdom  
Visiting Professor  
Epifaunal communities of hard marine substrata.

Susan Huntsman, Ph.D.  
Duke University Marine Laboratory  
Research Associate  
Phytoplankton nutrition and organometallic complexes in the sea.

William Kirby-Smith, Ph.D.  
Duke University Marine Laboratory  
Curator, Reference Museum  
Influence of food concentration on the growth of scallops.

Genevieve Payen, Ph.D., CNRS  
Laboratoire d'Evolution de la Faculte des Sciences de Paris  
Paris, France  
Research Associate  
Control of sexual differentiation in Crustacea.

Orrin Pilkey, Ph.D.  
Department of Geology  
Staff  
Sedimentation on the northern Hatteras and Hispaniola abyssal plains; Mapping of individual turbidity current flows.

Frank Schatzlein, Ph.D.  
California State University  
6101 E. 7th Street  
Long Beach, California  
Visiting Professor  
Acclimation of the oxygen consumption of crab larvae to temperature.

Richard B. Searles, Ph.D.  
Department of Botany  
Duke University  
Staff  
Study of the benthic communities on the continental shelf using facilities of *R/V Eastward*; and a descriptive study of the epiphytic algae which grow in the sounds on the blades of eelgrass and other marine angiosperms.

J. Bolling Sullivan, Ph.D.  
Duke University Marine Laboratory  
Staff  
Comparative aspects of protein chemistry.

John P. Sutherland, Ph.D.  
Duke University Marine Laboratory  
Staff  
Experimental studies on the dynamics of fouling communities.

Brigitte Volkmann, Ph.D.  
Istituto di Biologia Del Mare  
Riva 7 Martiri 1364/A  
30122 Venezia, Italy  
Visiting Professor  
Systematics and speciation in the genus *Tisbe* (Copepoda, Harpacticoida).

Adam Zsolnay, Ph.D.  
Duke University Marine Laboratory  
Research Scientist  
Heavy metals in marine environments.

#### GRADUATE STUDENTS ENGAGED IN THESIS RESEARCH

Sandra Allison, B.Sc.  
Department of Physiology and Pharmacology  
Duke University  
Water permeability of membranes.

Mary Bisson, B.A.  
Department of Botany  
Duke University  
Membrane physiology.

John Commito, B.A.  
Department of Zoology  
Duke University  
The regulation of estuarine soft bottom  
community structure.

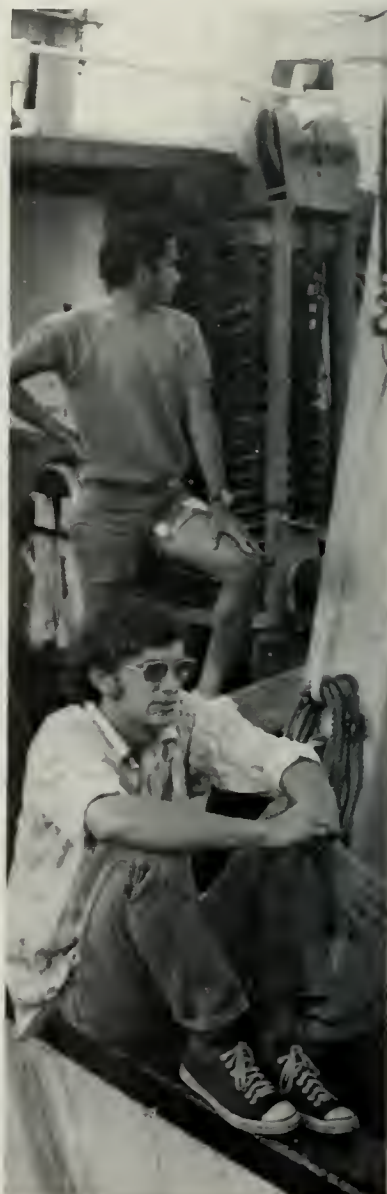
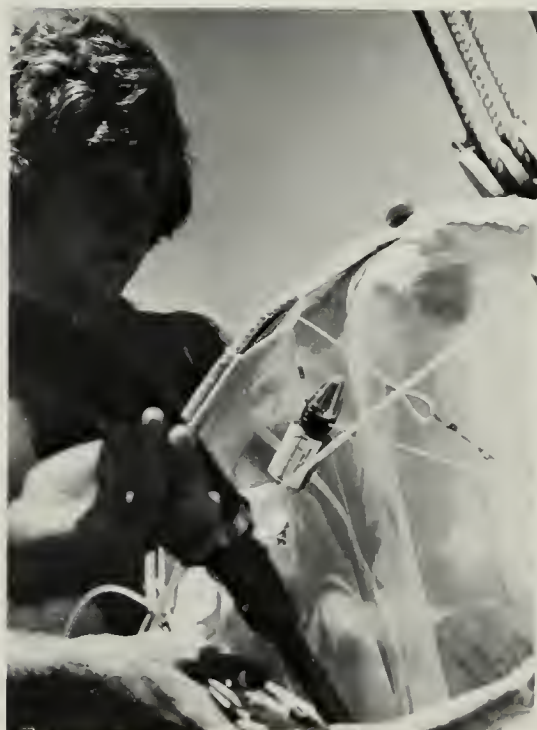
Timothy Cowles, M.A.  
Department of Zoology  
Duke University  
Feeding interactions among zooplankters.

Thomas Cronin, M.A.  
Department of Zoology  
Duke University  
Photophysiology of planktonic Crustacea.

Susan Currie, B.A.  
Department of Zoology  
Duke University  
Marine ecology.

Martha Farmer, B.S.  
Department of Physiology and Pharmacology  
Duke University  
The interaction of carbon dioxide with certain  
marine respiratory pigments.

John Freeman, M.S.  
Department of Zoology  
Duke University  
Hormonal control of molting.



Duncan Howe, B.A.  
Department of Physiology and Pharmacology  
Duke University  
Gill membrane transport in toadfish, *Opsanus tau*.

Burton Jones, B.S.  
Department of Zoology  
Duke University  
Modeling of phytoplankton growth in nutrient-rich unconditioned seawater.

Joseph Martin, B.S.  
Department of Zoology  
Duke University  
The functional significance of protein polymorphism in the oyster.

Walter Nelson, B.A.  
Department of Zoology  
Duke University  
Community dynamics of the epifauna of eelgrass beds.

Patricia Parsley, B.A.  
Department of Botany  
Duke University  
Phytoplankton community dynamics.

Lloyd Petrie, B.S.  
Department of Chemistry  
Duke University  
Complexometric methods of analysis for describing and evaluating effect of speciation in the ocean.

Walker Smith, B.S.  
Department of Botany  
Duke University  
Photosynthesis and phytoplankton primary productivity; phytoplankton excretion.

Terry L. West, M.S.  
Department of Zoology  
Duke University  
Settlement and metamorphosis in polychaetes.

#### GRADUATE STUDENTS HAVING RECEIVED DEGREES IN 1974-1975

Lesley Barling, M.A.  
Department of Zoology  
Duke University  
Orientation and growth of scallops relative to water current velocities.

Humberto Diaz, Ph.D.  
Department of Zoology  
Duke University  
Studies on settlement and recruitment process in the mole crab, *Emerita talpoida*.

Thomas Fisher, Ph.D.  
Department of Zoology  
Duke University  
Physiological ecology of marine suspension feeding organisms.

James Graves, Ph.D.  
Department of Physiology and Pharmacology  
Duke University  
Membrane transport processes in marine algae.

David Hastings, Ph.D.  
Department of Physiology and Pharmacology  
Duke University  
Membrane transport processes in marine algae.

Ronald Karlson, Ph.D.  
Department of Zoology  
Duke University  
The effect of sea urchin predation on the structure of an epibenthic, fouling community.

Freddy Losada, Ph.D.  
Department of Zoology  
Duke University  
Aspects of growth and shell deposition in barnacles.

Sharon Smith, Ph.D.  
Department of Zoology  
Duke University  
Copepod nitrogen excretion as a process in estuarine nutrient cycles.

#### R/V EASTWARD Personnel

Susan Barker, Seaman  
Ted Baxter, Wiper  
James Davis, Shore Engineer  
Clyde R. Everett, Steward/Messman  
Mark Fulford, Seaman  
James Harker, Second Mate  
James Jones, Seaman  
James Meyer, Oceanographic Party Chief  
Curtis Nelson, Chief Engineer  
George Newton, Oceanographic Party Chief

Curtis Oden, Bosun/Deck Engineer  
James Robinson, Oiler  
Mitchell Russell, Wiper  
Roger Shepherd, Head-Oceanographic Services  
Benjamin Smith, Cook/Messman  
Harold Willis, First Assistant Engineer  
Howard Wilson, Steward/Cook  
Harold Yeomans, Chief Mate

## Research Technicians

Lesley Barling, M.S.  
Shirley Bourne, M.A.  
William Bretz, Ph.D.  
Roselind Cronin  
Clarke Edwards, M.S.

Lucretia Garrigan, M.S.  
Gerald Godette, B.S.  
Teri L. Herbert, M.S.  
Sally Herring  
Penny Hooper, B.S.

Jane Kogelschatz, M.S.  
Louise Pennell, B.S.  
Rebecca Piver, B.S.  
Patrick Whaling





### Clerical Staff

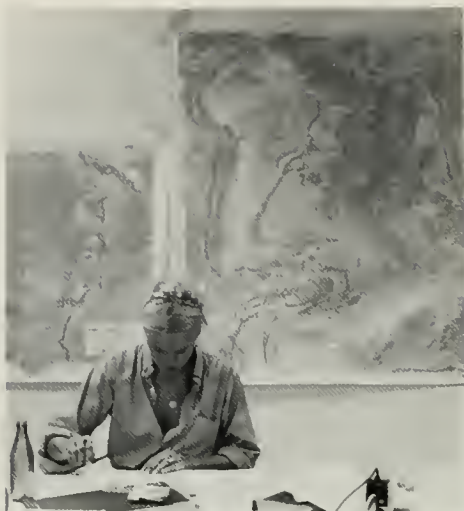
Linda Allred, Administrative Secretary  
Cindy Fowler, Senior Clerk Typist  
Dianne Gagnon, Senior Accounting Clerk  
Dorothy Johnson, Administrative Secretary  
Ellen Jones, Secretary

Lilian Lorenzsonn, Clerk Typist  
Estelle Merrell, Administrative Secretary  
Ruthella Rozier, Clerk Typist  
Sylvia Springle, Administrative Secretary  
Mamre Wilson, Secretary

### Technical Support Staff

David Bunting, Senior Draftsman  
Marzela Cain, Advanced Cook  
James Chadwick, Light Equipment Operator  
Annie Davis, Head Cook  
Claudia Davis, Housekeeper  
Clifton Davis, Senior Plumber  
Helen Davis, Housekeeper  
Annie Fulford, Housekeeper  
Catherine Gibbs, Housekeeper  
Gerona Griffin, Cook  
Horace Holland, Mechanic

William Hunnings, Senior Electronics Technician  
Melvin Jones, Housekeeper  
Irvin Moore, Carpenter  
Herman Myers, Senior Refrigeration/Air Conditioning Mechanic  
George Robinson, Boat Serviceman/Operator  
Sophia Turnage, Junior Buyer  
Mildred Tyre, Housekeeper  
Jean Williams, Senior Library Assistant  
James Willis, Boat Serviceman/Operator



APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY  
SUMMER SESSION

Name .....  
Please Print

Date .....

Social Security No. ....

Reserve a place for me in the following course(s): (Only one 6-unit course per term will be permitted; first and second choices may be indicated.) Each applicant should submit a transcript of grades to the Director.

FIRST TERM:

Course Number	Title of Course
.....	.....

SECOND TERM:

Course Number	Title of Course
.....	.....
.....	.....

THIRD TERM:

Course Number	Title of Course
.....	.....
.....	.....

Fees will be paid by: Self ..... Other .....

Reserve a room: Term I ..... Term II ..... Term III .....

Attended Summer Sessions at Duke University Marine Laboratory: Yes ..... No .....

Years .....

Request grade(s) be applied toward:	If college student, list:
Undergraduate credits .....	Undergraduate .....Year .....
Graduate credits .....	Graduate .....Year .....
General (unclassified) .....	

Name and address of school: .....

If teacher: List name and address  
of school .....  
.....  
.....

Male ..... Female ..... Married ..... Single .....

Colleges and/or universities attended and degrees: .....  
.....  
.....

Current address:	Forwarding address:
Street .....	Street .....
Rural Route or P. O. Box .....	Rural Route or P. O. Box .....
City..... State..... Zip .....	City..... State..... Zip .....

Mail to:  
Director  
Duke University Marine Laboratory  
Beaufort, North Carolina 28516



APPLICATION FOR ENROLLMENT IN THE DUKE UNIVERSITY MARINE LABORATORY  
SPRING SEMESTER MARINE SCIENCES PROGRAM FOR UNDERGRADUATE

Please type or print.

Date .....

1. Name .....  
Last First Middle

2. Social Security Number ..... Sex: Male ..... Female .....

3. Date of Birth: Month ..... Day ..... Year .....

4. A. Current mailing address:

City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

B. Permanent or home address:

City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

5. A. Present marital status: Single ..... Married .....

If applicable, give number of dependent children .....

B. Name and address of next to kin:

Name ..... Relationship .....

Address ..... City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

6. A. Duke University undergraduate student;

Trinity College of Arts and Sciences .....

Engineering .....

B. Special student desiring transfer credit:

Name and address of home institution .....

City ..... State ..... Zip .....

C. Major department ..... Class .....

7. The following persons have been requested to mail letters of recommendation to the Director of the Laboratory:

A. Name .....

.....

City ..... State ..... Zip .....

Area Code ..... Telephone Number .....

continued on reverse side

B. Name ..... Position .....  
.....  
City ..... State ..... Zip .....  
Area Code ..... Telephone Number .....

8. Transcript(s) will be sent by the following institution(s):

.....  
.....  
.....

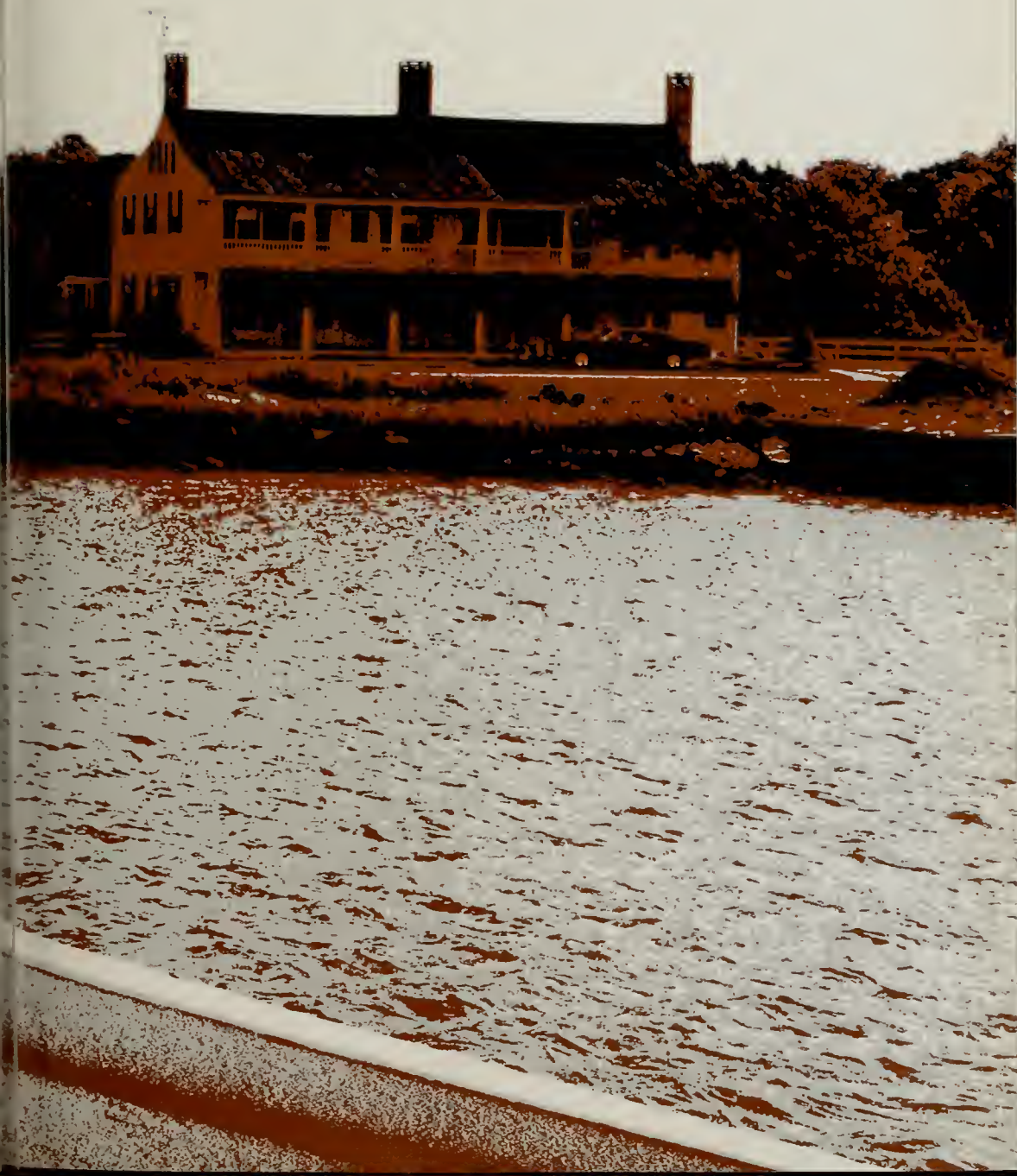
9. Have you ever been placed on probation or suspended or dismissed from any school?

Yes..... No..... (If yes, please explain below.)

Mail application to: Director

Duke University Marine Laboratory

Beaufort, North Carolina 28516







lletin of Duke University

1976-1977

The Graduate School





# Bulletin of Duke University

The Graduate School

1976-1977

Durham, North Carolina 1976

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson  
Duke University Bulletins Office

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Elizabeth Matheson

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## Contents

### **Introduction** 7

The Decision to Go to Graduate School	7
Choosing a Graduate School	8
Duration of Program	9

### **The Duke University Graduate School** 13

General Regulations Governing Graduate Studies	15
Admission	15
Earning the Degrees	18
The Language Requirement	19
Other Requirements	19
Financial Information	20
Calendar of the Graduate School	23

### **Advanced Degree Programs at Duke** with an abbreviated list of course offerings, 1976-77 25

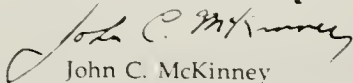
## To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report:

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education, Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.



John C. McKinney  
Dean of the Graduate School

# University Administration

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John O. Blackburn, Ph.D.

*Chancellor*

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William J. Griffith, A.B.

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William C. Turner, Jr., M.Div.

*Assistant Provost and Dean of Black  
Affairs*

Richard L. Wells, Ph.D.

*Assistant Provost and Associate Dean of  
Trinity College of Arts and Sciences*

Joel L. Fleishman, LL.M.

*Vice Chancellor for Public Policy  
Education and Research; Director of  
Institute for Policy Sciences and Public  
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William E. King, Ph.D.

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*Dean of the Graduate School*

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*Associate Dean*

Charles M. Harman, Ph.D.

*Associate Dean*

Pauline D. Myers

*Assistant to the Dean*

Frances C. Thomas, A.B.

*Administrative Assistant*

## Executive Committee of the Graduate Faculty

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Robert L. Barnes (Alt.)\*

Anne Flowers (Alt.)

Ernestine Friedl

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Gregory R. Lockhead (Alt.)\*

Francis Newton (Alt.)

Holger O. Nygard\*

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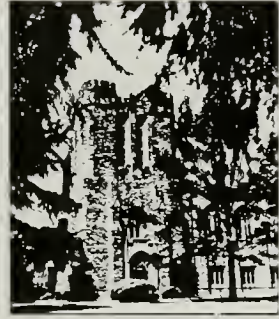
Hilda P. Willett\*

Franklin W. Young (Alt.)\*

\*Term expires September, 1976.







# Introduction

Writing in the 1920s the philosopher and man of science Alfred North Whitehead defined the purpose of a university in these terms: "The justification of a university is that it preserves the connection between knowledge and the zest for life, by uniting the young and the old in the imaginative consideration of learning." If this is true of a university generally, it is true of a graduate school especially. Faculty members and graduate students work together in the imaginative recasting of ideas necessary for successful research and the development of human knowledge.

Ideally, a graduate school is a community of scholars engaged in imparting and extending the realm of man's knowledge in the arts and sciences. A select group of students is admitted each year to undergo the rigorous discipline of an advanced degree program, the successful among them to emerge as scholars of promise. To enter upon graduate education today is to accept a real challenge, but this decision should not be made casually. The work toward a doctorate requires several years of tireless effort and possible sacrifice, and the material rewards may be less certain than in some alternative endeavor. However, pursued with determination, graduate education can be the doorway to a stimulating, creative, and meaningful life.

The student who is contemplating this challenge may have many questions in mind; the following pages are an attempt to answer some of them.

## The Decision to Go to Graduate School

The decision to work toward an advanced degree must be a personal commitment born of a willingness to devote oneself to many months or possibly years of academic discipline just at an age when one may be impatient for financial independence and freedom from academic discipline. Graduate education requires all the energy, enthusiasm, and self-discipline at one's disposal; to enter upon it half-heartedly is to invite discouragement or failure.

An equally important requisite for success in graduate study is the possession of a natural curiosity and the capacity for self-discipline. A good undergraduate record may or may not be adequate evidence of these characteristics. Many students with excellent undergraduate records have been unsuccessful in graduate study because their undergraduate training stressed an ability to marshal facts and to articulate these facts rather than real understanding and analysis of material. On the other hand, many distin-

guished scholars had undistinguished undergraduate records. In gaining admission to a graduate school, the undergraduate record is, of course, an important element, but usually some margin is left to allow for the student who develops a serious academic interest late in his undergraduate career. The student himself is often better able to judge whether his grade record is a true gauge of his ability.

There is no unerring way of knowing in advance whether one will be successful or happy in graduate school. It is quite likely, however, that if one has both the motivation and ability and does not try it, there will be regrets in later years. Although the decision must be an individual choice, superior intellectual ability is a scarce human resource, and the encouragement and utilization of it is a matter of community as well as personal concern.

## Choosing a Graduate School

Over two hundred and fifty universities today offer work leading to the Ph.D. degree. Among these are about sixty institutions which grant only two or three such degrees a year in all fields combined. At the other end of the scale are about fifty universities which account for nearly 70 percent of all doctorates granted in this country. Duke University is among these latter, as are most of the major institutions which offer programs ranging the breadth of academic disciplines. But even if one can narrow the field to about fifty major institutions, how does one select among these, and what factors should affect one's final choice? A few key factors are discussed briefly below.

**Size.** Size is not an infallible guide to the quality of a graduate school. There are a number of poor graduate schools of exceedingly large size and a number of extremely good small ones. However, it might be helpful simply to mention a few of the disadvantages of too many or too few students.

An extremely large graduate school—there are some which have between six and twelve thousand enrolled—is not the ideal of a small number of superior students working closely in intellectual pursuits with a few esteemed scholars. Classes of fifty to a hundred students, inaccessibility of senior faculty, shortage of library materials and facilities, only a nodding acquaintance with fellow students are only

a few of the possible drawbacks. An able student may develop well even in this atmosphere of mass production, but it is hardly the ideal.

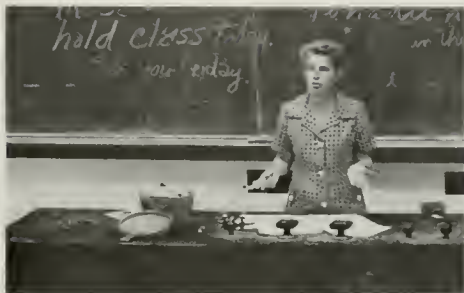
An extremely small graduate school also has its disadvantages. Facilities are often limited, and the faculty is likely to be primarily composed of undergraduate instructors. A university must be willing to commit a significant portion of its resources to develop a graduate program of high quality, and this often is not the case in an extremely small graduate school.

More important than the size of the entire graduate school is the size of the particular departmental program in which a student is interested. An optimum doctoral program will have an enrollment of perhaps thirty to one hundred students, admitting fifteen to forty new students each year, and turning out perhaps three to ten Ph.D.s per year. This information is usually available in university catalogues or government publications on higher education.

Duke University is committed to programs of moderate size in which the interests of the student are important. Total enrollment in the Graduate School is about nineteen hundred students. Between four and five hundred new students are admitted each year from approximately four thousand applications. Only four departments have more than eighty students; seventeen departments have enrollments that fall within the optimum range suggested in the preceding paragraph.

**Quality.** Not only do universities differ considerably in their reputation for quality, but there are marked differences among departments within any university. Many excellent universities have a few weak departments in which a student would fare less well than he might in an excellent department in a less esteemed institution. Therefore, the student should not be guided solely by the reputation of a university as a whole, but should inquire more specifically about the area in which he wishes to specialize.

Since judging the quality of a graduate program is necessarily subjective, no two people are likely to be in complete agreement. The prospective student would do well to talk with his professors in his undergraduate college, particularly those who have themselves achieved some reputation in the world of scholarship. As witnessed by their own continuing writing



and research, they are more likely to have reliable information on the merits of various graduate programs. Similarly, the younger faculty member who is only four or five years out of graduate school may have more recent acquaintances with his and other schools.

Another guide may be occasional questionnaires asking other educators to rank various graduate departments.

Alone, none of these guides is adequate; however, in conjunction with individual advice and recommendations, they can serve as useful indicators. In summary, the best procedure is to take as many factors as possible into account, and then to apply to three or four of the schools high in consideration. (Applying to fifteen universities is a waste of an applicant's and the universities' time.) Write to the graduate school or to the departmental director of graduate studies if further information is desired; visit the university in person, if possible; and carefully weigh the advice of distinguished faculty members of one's undergraduate college.

## Duration of Program

The length of time a graduate student spends in study toward an advanced degree depends upon the requirements of his individual program, on his personal work

habits, and on the environment of the graduate school and department in which he conducts his study.

The student's level of preparation before entering graduate school has a direct bearing on the speed with which he can progress toward a degree. A student who enters with proficiency in one or more foreign languages and a good foundation in his chosen field may well be able to finish within the minimum time limits. On the other hand, the student who is not as well prepared may find that one and a half to two years are the minimum for the A.M. degree, and four to five years for the Ph.D. degree (although wise use of the summers may reduce this time somewhat). The total time may also be lengthened if the student must work during part of his period of residence.

The attitude of the graduate school and its various departments will also affect the time needed to complete the degree. During the last decade the average time elapsing between entering graduate school and receiving the doctorate in American universities has been about ten years. A study of experience at Duke during the early 1950s indicated that the average doctorate in the humanities required a little over seven years, nearly six years in the social sciences, and slightly over four years in the

sciences. Over the last few years, however, Duke University has been among the fore-runners in reducing the time needed to obtain the Ph.D. without any sacrifice in quality. This effort has taken the form of trying to eliminate the unnecessary delays, particularly those due to financial burdens on the student. Duke ranks among the leading institutions in the country today in terms of financial aid per student from university sources. Moreover, much of this aid is in the form of fellowships and scholarships which do not require burdensome services in return. The large public institutions are often more restricted to awards which require substantial teaching, research, or other duties, thus reducing the speed with which a student can complete his resident course work. A student will be wise to inquire to what extent his progress toward a degree may be delayed by the work entailed in certain awards. If for example, an assistantship lengthens unduly the time necessary to obtain a degree, even a smaller fellowship may be preferable.

Another way in which Duke encourages deliberate speed toward fulfilling degree requirements is through its tuition charges. Many graduate schools charge tuition for three full years in a doctoral program. In 1958 Duke adopted the policy of charging full tuition and fees only up

to the time the doctoral student passes his preliminary examination. (This examination is taken upon completion of all course and language requirements, usually at the end of the second year, before the student is formally admitted to candidacy for the Ph.D.) After "prelims," tuition charges are substantially reduced. In making his choice of a graduate school, a prospective student should inquire about the fees for a full doctoral program, not merely the charges for the first year. The tuition and fee system at Duke has worked to encourage both the student and his department to arrange for preliminary examinations to be taken before the beginning of the third year. Some years ago fewer than half of the doctoral students at Duke took this examination before the beginning of the third year; today over 90 percent are doing so. This plan, aided by scholarship and fellowship aid, gives the graduate student at Duke a marked advantage over his counterparts in many other graduate schools in acquiring his degree in the minimum amount of time.

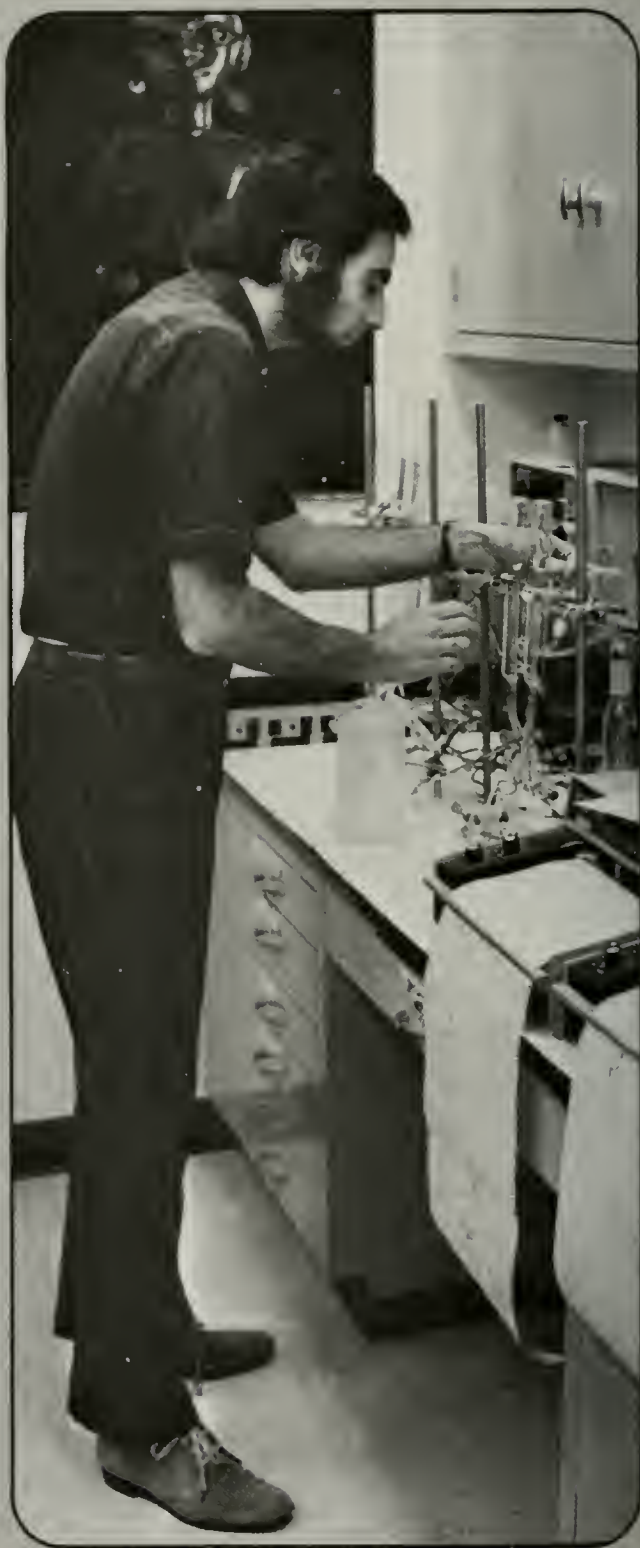
The duration of the graduate program, therefore, depends on many factors, but the policy of the Duke Graduate School is to keep the length of time a student is involved in obtaining an advanced degree at a minimum.

### **Policy of Nondiscrimination**

Duke University does not discriminate on the basis of race, color, national and ethnic origin, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other University program or activity. It admits qualified students of any race, color, national and ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.









# Duke University Graduate School

In surveying the progress made in the first seven years after the founding of Duke University, its first President, William Preston Few, wrote that he wanted "to see the Graduate School made strong because it will best and most quickly insure our attaining and maintaining a place of real leadership in the educational world." President Few believed that "more than anything else here our Graduate School will determine the sort of University we are to build and its standing in the educational world." These opinions have continued to prevail to the present day, with emphasis upon the interdependence of teaching and research as the necessary components of scholarship.

Over five hundred members of the graduate faculty teach the approximately six hundred courses and seminars offered in the Graduate School, and supervise thesis and dissertation research. Many of the major universities of the world have helped to train this faculty; approximately 90 percent of the graduate staff hold degrees from the forty-six institutions which make up the Association of Graduate Schools within the Association of American Universities. By place of birth they represent almost every state in the nation and almost two dozen foreign countries.

The nineteen hundred graduate students currently enrolled represent a similar diversity in background. Approximately

41 percent of the students recently completing doctoral degrees are from undergraduate colleges in the Southeast, 16 percent from the Middle Atlantic states, 12 percent from New England, 11 percent from the Central states, 7 percent from the Southwest, 2 percent from the Northwest, 1 percent from the Far West, and 10 percent from foreign countries.

The groundwork for learning may be laid in privacy—indeed a certain amount of private study and research is absolutely essential—but the vital stimulus to the learning process comes from one's contact with the minds of other people with similar or related interests. This is precisely why graduate schools are highly selective in their admissions policy, and it is one of the important reasons for their willingness to offer attractive fellowship awards to outstanding students. The superior student is a valuable catalyst both for his fellow students and for his faculty and is prized as such.

Faculty and students comprise the essential human factors in education, but their joint endeavor cannot prosper without adequate research and library facilities. Duke University is particularly fortunate in regard to research facilities, for the physics, botany, zoology, chemistry, psychology, sociology, engineering, and biochemistry laboratories have been built entirely within recent years, and modernization



and expansion have occurred in other scientific areas. The University has an excellent Computation Center on the campus and shares a computing facility with the University of North Carolina and North Carolina State University. The Triangle Universities Computation Center is among the largest research-oriented computer facilities in the world. The University has a fine research library; the twentieth largest university library in the nation, second in the South, and first in the Southeast. In number of volumes, breadth of coverage, serials, and documents, it is a much more adequate library than that available in many graduate schools with an enrollment two or three times as large. To the student in the arts, humanities, and social sciences, for whom the library is the bloodstream of scholarship, this is an immeasurable asset.

Among the many special features of the Graduate School a few important examples may be mentioned. For students in the biological and physical sciences, the facilities of the Duke Marine Laboratory at Beaufort, North Carolina, are available for course work and research. The Laboratory has research buildings, classrooms, motor vessels (including the 118-foot oceanographic ship, the *R/V Eastward*), and living quarters, which make it an excellent research center in marine biology. Closer to home are the 8,000 acres of the Duke Forest, managed by the School of Forestry, ideal for research on timber growth, soils, and related topics. A Regional Nuclear Structure Laboratory is housed on the campus and serves the major universities in the area. A phytotron, adjacent to the botany greenhouses, allows for the duplication of environmental conditions found anywhere in the world.

Additional resources and facilities are available to the graduate student because of Duke's fine Schools of Law, Medicine, Engineering, Forestry and Divinity. A three-term summer session and the availability of courses at the nearby University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh under a cooperative arrangement offer other opportunities to the graduate student.

No description of programs can begin to give the prospective student the full flavor of graduate study in a particular institution. A visit to the universities in which one is particularly interested

may be helpful in giving one a better picture. If this should be practical, the Duke Graduate School offers a warm invitation to prospective students to come to the campus during the year to discuss their possible application and admission. The visitor will find at Duke most of the facilities that one could hope for in the largest of institutions, and yet the University has been fortunate in avoiding many of the evils inevitable with mass education. Despite the total University enrollment of approximately 9,000, Duke has retained the sense of community that one usually associates with a smaller liberal arts college. And in an age when current architectural whim often adds yet one more variant style to an already assorted array of buildings, Duke has built a campus of unusual and architecturally coherent beauty. This, too, is an important part of education, creating an environment conducive to learning.





## Special Programs

Special and cooperative programs at Duke include:

- Center for the Study of Aging and Human Development
- Canadian Studies Program
- Center for Commonwealth Studies
- Program in Comparative Studies on Southern Asia
- Cooperative Program in Teacher Education (Secondary M.A.T. Degree)
- Cooperative Program (with the University of North Carolina at Chapel Hill) in Russian and East European History
- Center for Demographic Studies
- Duke Environmental Center
- University Program in Genetics
- Hispanic Studies Program
- Medical Scientist Training Program
- Medical Historian Training Program
- Program in Medieval and Renaissance Studies
- Predoctoral Training Program in Sciences Related to the Nervous System
- Oak Ridge Institute of Nuclear Studies
- Organization for Tropical Studies
- Institute for Policy Sciences and Public Affairs
- Round Table on Science and Public Affairs
- Social Systems Simulation Program
- Center for Southern Studies (including the Oral History Project)

Further information may be obtained by writing the individual program c/o Duke University, Durham, North Carolina 27706 or by writing the Graduate School Office.

## General Regulations Governing Graduate Studies

The official detailed *Bulletin of the Graduate School*, published in March of each year, gives an account of regulations concerning graduate work at Duke University and a full description of course content. The following pages are a summary of these materials for 1976-77 and should provide sufficient information for the prospective student. The *Bulletin* is normally mailed to each student who is admitted to the Graduate School in the late spring of the year of matriculation so that he may plan his course program for the first year. Copies may be obtained in April, however, by writing to the Graduate

School Office, Duke University, Durham, North Carolina 27706.

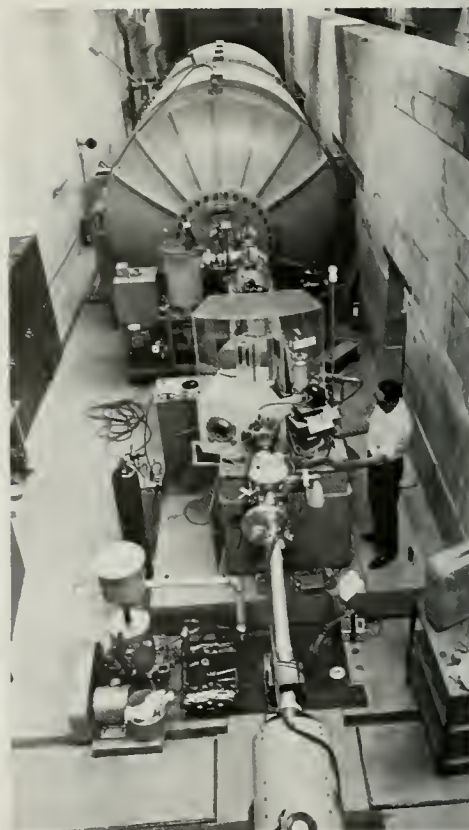
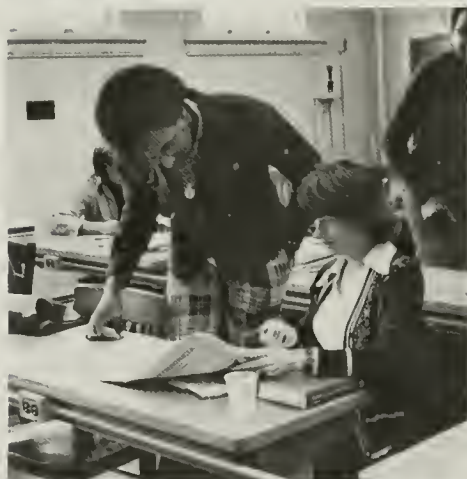
## Admission

All applicants will be considered without regard to race, color, religion, sex, or national origin.

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who desire credit for whatever purpose for graduate courses—except students who register as special students in the Summer Session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program.

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Ordinarily the student should have majored in the area of intended graduate study. Many departments (see the section on Advanced Degree Programs at Duke) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see the section on Language Requirement).

**Procedures.** A student seeking admission to the Graduate School should request the Dean of the Graduate School to send an application blank. This should be filled out completely and returned promptly. Each application must be accompanied by a nonrefundable fee of fifteen dollars in check or money order payable to Duke University. In addition, the student is required to provide the following supporting documents: (1) two copies of the official transcript from each college, university, or seminary attended sent to the Dean directly by the institution; (2) as soon as possible, two supplementary transcripts showing completion of work which was in progress when the earlier transcript was made; (3) three letters of recommendation, written on the forms provided, by persons best qualified to



judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Test for all departments; and (5) scores on the Graduate Record Examination Advanced Test for the Departments of Biochemistry, Botany, Chemistry, English, Mathematics, Microbiology, Pathology, Physics, Physiology,

Romance Languages, Sociology, and Zoology.

Applicants to the Department of Health Administration are required to take the Graduate Management Admission Test, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate

Record Examination no later than the October testing in order to meet the February 1 deadline. Information on times and places of the Graduate Record Examinations can be provided at the applicant's college or by the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with application materials (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through the Educational Testing Service in Princeton, New Jersey; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are \$6,200), and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack the necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program by 3 units.

A student who does not successfully complete this course during the first year of residency will not be permitted to continue graduate work at Duke University. Passing this examination or the course, if

it is required, will not meet degree requirements for a foreign language.

When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is not complete until the student returns the acceptance form.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. *Nondegree admission* is offered to students who meet the admission requirements and who desire to engage in graduate study not subject to the restrictions of a graduate degree program. With the approval of the student's major department and the Dean of the Graduate School, a maximum credit of 6 units earned under nondegree status may be applied toward an advanced degree at Duke University if and when the student is granted full admission.

It is the applicant's responsibility to make certain that the Graduate School Office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted two weeks before the closing dates listed below.

We encourage all candidates to apply by February 1. Anyone whose folder is not complete before that date will face the possibility that departmental enrollment will have been filled. Although the Graduate School Office will process later applications, it cannot guarantee full consideration of a folder for any department after April 15.

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Fall semester, admission and award .....	February 1
Fall semester, admission only .....	July 15
Spring semester, admission only .....	December 1
Summer session, 1977* first term .....	April 15
Summer session, 1977* second term .....	May 15
Summer session, 1977* third term .....	June 15

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\*Students seeking admission to the Graduate School for study in the summer session should apply to the Dean of the Graduate School and to the Director of the Summer Session.





## Earning the Degrees

Duke University offers graduate programs leading to the specified advanced degrees in the following fields:

Anatomy, A.M., Ph.D.  
 Anthropology, Ph.D.  
 Art History, A.M.  
 Biochemistry, Ph.D.  
 Biomedical Engineering, M.S., Ph.D.  
 Botany, A.M., M.S., M.A.T., Ph.D.  
 Business Administration, \*Ph.D.  
 Chemistry, A.M., M.A.T., Ph.D.  
 Civil Engineering, M.S., Ph.D.  
 Classical Studies, Ph.D.  
 Computer Science, A.M., Ph.D.  
 Economics, A.M., Ph.D.  
 Education, M.Ed., M.A.T., A.M., Ed.D.,  
 Ph.D.  
 Electrical Engineering, M.S., Ph.D.  
 English, A.M., M.A.T., Ph.D.  
 Forestry, A.M.,† M.S., Ph.D.  
 Geology, M.S., Ph.D.  
 Germanic Languages and Literature, A.M.

Health Administration, M.H.A.  
 History, A.M., M.A.T., Ph.D.  
 Mathematics, A.M., M.A.T., A.M., M.S.,  
 ‡ Ph.D.  
 Mechanical Engineering and Materials  
 Science, M.S., Ph.D.  
 Microbiology and Immunology, Ph.D.  
 Pathology, M.S., Ph.D.  
 Philosophy, A.M., Ph.D.  
 Physical Therapy, M.S.‡  
 Physics, A.M., Ph.D.  
 Physiology, A.M., Ph.D.  
 Political Science, A.M., Ph.D.  
 Psychology, A.M., Ph.D.  
 Religion, A.M.,§ Ph.D.  
 Romance Languages, A.M., Ph.D.  
 Sociology, Ph.D.  
 Zoology, A.M., M.A.T., Ph.D.

\*In addition to the Ph.D. degree in the Graduate School, the School of Business Administration offers the professional degrees of Master of Business Administration and Master of Management.

†In addition to the regular advanced degrees in the Graduate School, the School of Forestry offers the professional degrees of Master of Forestry and Doctor of Forestry.

‡Prospective applicants should write directly to the Department of Physical Therapy, Box 3247, Duke Medical Center, Durham, N. C. 27710, for further information.

§In addition to the regular advanced degrees in the Graduate School the Divinity School offers the professional degrees of Master of Divinity, Master of Religious Education, and Master of Theology.

||In addition to the regular advanced degrees in the Graduate School, the Department of Mathematics offers the Master of Science in Statistics and Computing.



## The Language Requirement

Although individual departments establish their own minimal requirements (see individual departmental headnotes in this *Bulletin*), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. The languages normally required are French, German, and Russian, but others may be offered if appropriate and approved. The foreign language requirement may be satisfied in the following ways: (1) by a passing score on one of the ETS examinations administered at any national center (including Duke) and taken no longer than six years before the preliminary examination, (2) by transfer from another institution, with the limitations set forth in the more detailed *Bulletin of the Graduate School*, (3) in any language for which ETS tests are not available, by a reading examination administered by a qualified examiner and arranged by the Graduate School Office, or (4) by a reading examination in any foreign language, administered by a qualified member of the faculty under a procedure specified by the department and approved by the Dean and the Executive Committee of the Graduate Faculty. In special circumstances a department that wishes to do so may ask the Dean and the Executive Committee of the Graduate Faculty to waive the language requirement.

Foreign students whose native language is not English will be examined during their first registration period in their use of English, and those found deficient will be required to enroll in the course entitled English for Foreign Students. Advanced level, non-credit reading courses in French and German are provided for students who need them.

## Other Requirements

The general requirement for a master's degree is a *minimum* of 30 units (semester hours) of course-seminar-research credit. The student must present acceptable grades for a minimum of 24 units of graduate courses. The nature of the additional 6 units for which he must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., these last 6 units are earned either with successful submission of the thesis or with such other courses or academic exercises as are approved by

the student's department. In the M.A.T. program, practice teaching is included for students who lack it, and for them the total units required is a minimum of 36. A pattern of major and related work is prescribed for the course-seminar work, allotting half or more of the units to the major. For example, the M.Ed. program allows at least half the units to fall within the student's teaching field, and the M.A.T. allows a major in either education or teaching fields, according to the student's previous training.

A master's program can be completed in one academic year, but the student who presents a thesis usually needs at least a calendar year, and foreign students should be prepared to study for two years. The maximum length of time permitted from first registration to completion of all requirements is six years. Under certain circumstances a maximum credit of 6 units may be transferred toward the master's degree for graduate courses completed elsewhere, provided the grades earned in the particular courses were not less than *B* or equivalent. In such a case, however, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.

The course-seminar-research requirement in the doctoral program is a minimum of 60 units, but the proportions of course-seminar work and research are generally flexible according to the student's needs. The applicant who has already earned the A.M. or M.S. (or for a degree in religion, the B.D. or M.Div.), after establishing the quality of his work here may be granted transfer credit to a maximum of 30 units, i.e., the equivalent of one year of residence. The dissertation is expected to be a mature and competent piece of writing, embodying the results of original and significant research. All dissertations will be published on microfilm, and the author may retain copyright privileges.

Fairly strict time limitations are set for completion of the doctoral program. The preliminary examination, which may be taken only after language and course-seminar requirements have been met, and which formally admits a student to candidacy for the degree, should be passed by the end of the third year of doctoral study. The interval between preliminary examination and presentation of an acceptable dissertation should ordinarily be one to



two years and may not be more than four years without special approval by the Dean. Should this interval extend beyond five years, a second preliminary examination usually becomes necessary.

### Financial Information\*

Tuition and fees are charged at the rate of \$96 per unit (a unit is equivalent to a semester hour), with the normal full program of study being 30 units for an academic year. Upon successful completion of the preliminary examination and two years of residence, the normal full program during the dissertation period is 3 units per semester while in residence, or 1 unit per semester while not in residence. The basic necessary expenses for a year of graduate study, assuming one lives in University graduate dormitories, are therefore approximately as follows:

	<i>First and Second Year</i>	<i>Dissertation Year</i>
Tuition	\$2,880	\$576
Room Rent† (Graduate Center)	460	460
Board‡	850	850

\*The figures contained in this section are based on tuition and fees for the 1975-76 academic year and are subject to change without notice.

†Depending upon accommodations chosen.

‡Cafeteria estimate.

Additional allowances should be made for books, laundry, and other personal expenditures.

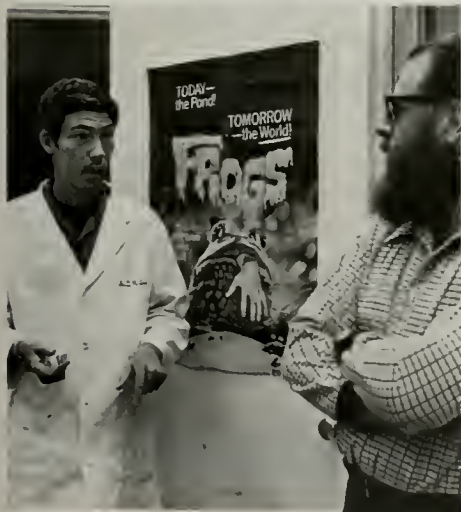
Housing is provided for approximately 149 single men and 56 single women in the Graduate Center. The Town House Apartments, located between East and West Campuses, will accommodate both families and single students in 30 air-conditioned apartments.

Central Campus Apartments, completed in 1975, accommodate married and single students from the University and the Medical Center.

For single graduate professional students, one-bedroom and three-bedroom apartments will be furnished; a few furnished efficiencies are available. It is expected that many more applications will be received for efficiencies than can be accommodated.

**Financial Aid.** In recent years at Duke about two-thirds of all full-time students have held an award of some type; about one-third of these were aided by Duke funds and the other two-thirds by funds from other sources.

The student who seeks financial aid from Duke University should be certain that he files his request for admission and award not later than February 1 of the year in which September admission is sought. The application for admission, including transcripts of previous college work and letters of recommendation, is processed by





the Graduate School and forwarded to the department in which the student wishes to pursue advanced work. The graduate faculty—or admissions committee—in the department reviews all applications and then makes its recommendation to the Dean for announcement in late March. The most outstanding applicants are then offered awards; the next in order of rank are placed on an alternate list for awards. Other students are offered only admission to the Graduate School. Because of multiple applications by students, a fraction of the awards offered by any graduate school are turned elsewhere. Alternates on the award list are immediately notified, and the process continues until the desired number of awards has been made.

Awards to entering students at Duke are in the form of fellowships, scholarships, and assistantships.

**James B. Duke Graduate Fellowships** are provided through a special endowment of the Duke Endowment. Fellows are chosen from nominations made by the departments. Only outstanding applicants who are seeking the Ph.D. degree are considered. These nominations are made in late February and are judged in a competition which includes candidates from all departments granting the Ph.D. degree. These fellowships provide for payment of tuition for full registration and a stipend of \$325 per month for the full calendar year during each of the three years of the award. The award requires no service beyond that

which is required of all students in a given department as a part of their training and is renewable each year upon satisfactory progress toward the degree at a fellowship level of quality. The total value of a James B. Duke Fellowship over the full three years of tenure is over \$18,000 at current tuition rates.

**Graduate Fellowships** range in value to \$5,800 for the academic year and are made on a year-to-year basis. They are awarded upon recommendation by each department. No service is required as a prerequisite for accepting a fellowship, but all fellowship holders are expected to maintain full-time registration.

**Graduate Scholarships** provide for payment of tuition or partial tuition. Full tuition scholarships are valued at \$2,800 for the academic year. Scholarships are awarded upon recommendation of each department.

**Graduate Assistantships** range in value to \$4,800 for the academic year. Assistants may be permitted to reduce their registration to 12 or 9 units, depending on the amount of service required. Residence credit as a full-time student is allowed under these circumstances. Assistantships are most common in the science departments, where the student often provides laboratory assistance to various members of the faculty. Most graduate assistants remain in residence during the





summer sessions carrying research or course credit. In this way, the normal progress toward a degree is not impeded by the reduced load during the fall and spring semesters. Departmental research funds are often available to provide financial assistance during the summer.

Other graduate fellowships are available from foundations, industry, or the government. Among those at the University's disposal are James B. Duke Commonwealth Fellowships for students in political science, economics, and history who are concentrating their studies on the British Commonwealth; Kearns fellowships in religion; Medieval and Renaissance Studies fellowships; and Cokesbury awards for the preparation for college teaching. In 1975-1976 four students held Foreign Language Fellowships awarded by Duke University under Title VI of the National Defense Education Act in Southeast Asia Area Studies. Over 300 other traineeships and assistantships are available in the biological, physical, and social sciences under grants from National Institutes of Health, National Institutes of Mental Health, National Science Foundation, research agencies in the Department of Defense, and other governmental agencies.

**Loans** may be obtained through the National Direct Student Loan Fund and through the Federal Insured Student Loan Program. In addition, the University provides loans from funds set aside for this purpose. Particular eligibility require-

ments must be met for each program. All require that need criteria be met, but funds under favorable terms are expected to be available to meet legitimate requests. Further information may be obtained from the Graduate School Office.

It is difficult to estimate a student's financial needs during the years of graduate study because of individual tastes and habits. One can predict with some accuracy, however, the three major items of expense at Duke: tuition, \$2,880 for a full program for each of the first two years, usually \$576 for the Ph.D. dissertation year; room rent, \$460 each year in graduate dormitories; and board, approximately \$800-\$900 in graduate dining halls. Students holding awards are usually paid in nine equal installments beginning in late September, and tuition and room fees may be deducted monthly on a pro rata basis.

The costs of graduate education are high, but Duke University attempts to allocate its funds so that the superior student is able to finish his work for a degree in the normal length of time regardless of his personal financial resources. This is a contribution to the community of scholarship which the University is glad to bear.

The applicant who wishes further information on facilities and regulations on course programs not covered in this *Bulletin* is invited to write to the Director of Admissions of the Graduate School, or the director of graduate studies in the department of intended study.

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## Calendar of the Graduate School

### Summer Session 1976

First Term: May 11-June 12  
Second Term: June 14-July 16  
Third Term: July 19-August 20

### Academic Year 1976-1977

First Semester: September 7-December 21  
Second Semester: January 10-May 2

August 30 .....	Registration for First Semester
September 7 .....	Classes Begin
November 24-28 .....	Thanksgiving Recess
December 8-14 .....	Reading Period
December 21 .....	End of First Semester
January 7 .....	Registration for Second Semester
January 10 .....	Classes Begin
March 5-13 .....	Spring Recess
April 19-25 .....	Reading Period
May 2 .....	End of Second Semester
May 8 .....	Commencement

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# Advanced Degree Programs\*

## Anatomy

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core of anatomical science courses (Anatomy 305, 307, 309) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas. Some idea of the opportunities for degree research may be gleaned from the description of Anatomy 312. For further information contact the Director of Graduate Studies.

### Professors

John Wendell Everett, Ph.D. (Yale); J. Moses, Ph.D. (Columbia); Talmage Lee Peele, M.D. (Duke); J. David Robertson, M.D. (Harvard), Ph.D. (Massachusetts Inst. of Tech.), *Chairman*.

### Associate Professors

Matthew Cartmill, Ph.D. (Chicago); Sheila J. Counce, Ph.D. (Edinburgh); Kenneth Lindsay Duke, Ph.D. (Duke); William Hylander, Ph.D. (Chicago); William Longley, Ph.D. (London); Michael K. Reedy, M.D. (Washington).

### Assistant Professors

Mark Adelman, Ph.D. (Chicago), *Director of Graduate Studies*; Charles Blake, Ph.D. (California at Los Angeles); Joseph Corless, M.D., Ph.D. (Duke); Harold Erickson, Ph.D. (Johns Hopkins); William Fletcher, Ph.D. (California at Berkeley); William C. Hall, Ph.D. (Duke); Kurt E. Johnson, Ph.D. (Yale); Richard F. Kay, Ph.D. (Yale); Moses S. Mahaley, M.D., Ph.D. (Duke), Timothy Strickler, Ph.D. (Chicago); Lee Tyrey, Ph.D. (Illinois).

### Adjunct Assistant Professors

Jan Bergeron, V.M.D. (Pennsylvania); Adelaide T. C. Carpenter, Ph.D. (Washington).

### Lecturer

Irving T. Diamond, Ph.D. (Chicago).

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\*For full course descriptions including credit and name of instructor see the official detailed *Bulletin of the Graduate School*.

### Courses of Instruction

- 207. Human Anatomy
- 208. Anatomy of the Trunk
- 212. Cellular Endocrinology
- 215. Contractile Processes
- 216. Biological Psychology
- 217. Structure and Function of Visual Photoreceptors
- 219. Molecular and Cellular Basis of Development
- 219S. Seminar
- 231. Human Evolution
- 238. Function and Evolutionary Morphology of Primates
- 240. Mechanisms of Biological Motility
- 246. The Primate Fossil Record
- 261. History of Generation and Mammalian Reproduction
- 263. History of Anatomy
- 264. Mammalian Embryology and Developmental Anatomy
- 265. Seminar in Chromosome Biology
- 266. Seminar in Chromosome Biology
- 276. Neuroanatomical Basis of Sensory Physiology
- 280. Structure and Assembly of Macromolecules
- 286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology
- 288. Seminar on the Role of the Cell in Development and Heredity
- 291. Special Topics in Nerve Ultrastructure
- 300. Gross Anatomy
- 303. Neuroanatomical Basis of Behavior
- 305. Gross Human Anatomy
- 307. Microscopic Anatomy
- 309. Neuroanatomy
- 312. Research
- 313, 314. Anatomy Seminar
- 340. Tutorial in Advanced Anatomy
- 344. Advanced Neuroanatomy of Sensory and Motor Mechanisms
- 354. Research Techniques in Anatomy
- 418. Reproductive Biology

## Anthropology

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for the Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these sub-fields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. degree by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's progress.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies, Department of Anthropology.

### Professors

Richard G. Fox, Ph.D. (Michigan); Ernestine Friedl, Ph.D. (Columbia), *Chairman and Director of Graduate Studies*; Weston LaBarre, Ph.D. (Yale), *James B. Duke Professor of Anthropology*.

### Associate Professors

Mahadev L. Apte, Ph.D. (Wisconsin); Matthew Cartmill, Ph.D. (Chicago); William Hylander, Ph.D. (Chicago); William M. O'Barr, Ph.D. (Northwestern); Lawrence Rosen, J.D., Ph.D. (Chicago); Carol A. Smith, Ph.D. (Stanford).

### Assistant Professors

James Boon, Ph.D. (Chicago); Ronald W. Casson, Ph.D. (Stanford); Kenneth E. Glander, Ph.D. (Chicago); Naomi Quinn, Ph.D. (Stanford); Carol Stack, Ph.D. (Illinois).

### Courses of Instruction

- 210. Linguistic Anthropology: Theory
- 211. Linguistic Anthropology: Ethnography of Communication
- 220S. Society and Culture in India
- 222. Topics in African Anthropology
- 242. Topics in Prehistory
- 243. Theory and Method in Archeology
- 244. Primate Behavior
- 245. Functional and Evolutionary Morphology of Primates
- 246. The Primate Fossil Record
- 249. Topics in Economic Anthropology
- 250. The Anthropology of Cities
- 251. Ethnography of Humor
- 259. Linguistic Anthropology: Language Acquisition
- 264. Primitive Religion
- 265. Personality and Society
- 266. Personality and Culture
- 267. Cognitive Anthropology



- 268. Law and the American Indian
- 270. Ethnographic Field Methods
- 271. Methods of Data Analysis
- 272. Primitive Music
- 273. Primitive Art
- 275. Rank, Power, and Authority in Pre-Industrial Societies
- 276. Analysis of Kinship Systems
- 277. Class, Ethnicity, and Public Policy
- 278S. Special Topics in Political Anthropology
- 280S, 281S. Seminar in Selected Topics
- 291, 292. Anthropological Theory
- 330, 331. Seminar in Anthropology
- 334. Topics in Physical Anthropology
- 335, 336. Linguistic Theory and Methods
- 393. Individual Research in Anthropology
- 402. Interdisciplinary Seminar in the History of the Social Sciences
- 410. Seminar in the Government, History, and Social Structure of India and Pakistan

## Art

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. The candidate must also pass a written comprehensive examination testing his knowledge of art history and pertinent bibliographical resources.

### Professors

Marianna Jenkins, Ph.D. (Bryn Mawr); Sidney David Markman, Ph.D. (Columbia), *Director of Graduate Studies*; Earl George Mueller, Ph.D. (Iowa State); Elizabeth Read Sunderland, Ph.D. (Radcliffe).

### Assistant Professor

Sara Lichtenstein, Ph.D. (London).

### Courses of Instruction

- 233. Early Medieval Architecture
- 237. French Renaissance Art
- 244. Neoclassicism
- 247. Problems in the History of Graphic Arts
- 249. Problems in Pre-Columbian Art and Archeology
- 250. Problems in Latin American Art
- 254. Problems in Modern Architecture
- 257, 258. Problems in Modern Art
- 259. Romanticism
- 293, 294. Special Problems in Art History

## Asian Languages

Hindi-Urdu 200-201. Special Studies in South Asian Languages

## Biochemistry

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The Division of Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

### Professors

Irwin Fridovich, Ph.D. (Duke); Samson R. Gross, Ph.D. (Columbia), *Director of the Genetics*

*Division*; Walter R. Guild, Ph.D. (Yale); Philip Handler,\* Ph.D. (Illinois); Jerome S. Harris, M.D. (Harvard); Robert Hill, Ph.D. (Kansas), *Chairman*; Henry Kamin, Ph.D. (Duke); Norman Kirshner, Ph.D. (Pennsylvania State); Kenneth S. McCarty, Ph.D. (Columbia); Charles Tanford, Ph.D. (Princeton), *James B. Duke Professor of Physical Biochemistry*.

#### Associate Professors

Stanley H. Appel, M.D. (Columbia); Ronald C. Greene, Ph.D. (California Inst. of Tech.); Bernard Kaufman, Ph.D. (Indiana); Sung-Hou Kim, Ph.D. (Pittsburgh); William Sanford Lynn, M.D. (Columbia); K. V. Rajagopalan, Ph.D. (Univ. of Madras), *Director of Graduate Studies*; Jacqueline A. Reynolds, Ph.D. (Washington); David C. Richardson, Ph.D. (Massachusetts Inst. of Tech.); Harvey J. Sage, Ph.D. (Yale); Lewis M. Siegel, Ph.D. (Johns Hopkins); Robert E. Webster, Ph.D. (Duke).

#### Assistant Professors

Robert Bell, Ph.D. (California at Berkeley); Robert L. Habig, Ph.D. (Purdue); Dwight H. Hall, Ph.D. (Purdue); Nicholas M. Kredich, M.D. (Michigan); Robert J. Lefkowitz, M.D. (Columbia); P. A. McKee, M.D. (Oklahoma); James B. Sullivan, Ph.D. (Texas); Robert W. Wheat, Ph.D. (Washington Univ.).

#### Associates

John A. Bittikofer, Ph.D. (Purdue); Joseph Bonaventura, Ph.D. (Texas); Joe M. McCord, Ph.D. (Duke); Yasuhiko Nozaki, Ph.D. (Tokyo Univ.); Howard Steinman, Ph.D. (Yale).

#### Courses of Instruction

- |   |   |
|---|---|
| 204. Introductory Genetics                              | 282. Experimental Genetics                              |
| 209-210. Independent Study                              | 284. Current Topics in Genetic Mechanisms               |
| 216. Molecular Genetics                                 | 286. Current Topics in Immunochemistry                  |
| 219. Molecular and Cellular Basis of Development        | 288. The Carbohydrates and Lipids of Biological Systems |
| 219L. Laboratory  | 290. Bioenergetics                                      |
| 219S. Seminar   | 293. Macromolecules                                     |
| 220. Adaptations of Organisms to the Marine Environment | 295. Enzyme Mechanisms                                  |
| 222. Structure of Biological Macromolecules             | 296. Biological Oxidations                              |
| 224. Biochemistry of Development and Differentiation    | 297. Intermediary Metabolism                            |
| 241. General Biochemistry                               | 299. Nutrition  |
| 248. Introductory Biochemistry                          | 302. Neurochemistry                                     |
| 276. Comparative and Evolutionary Biochemistry          | 345, 346. Biochemistry Seminar                          |
|   | 351, 352. Genetics Seminar                              |
|   | 390. Biochemistry of Membranes                          |

## Botany

Graduate work in the Department of Botany is offered leading to the A.M. (non-thesis), M.S. (thesis), and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

#### Professors

Lewis Edward Anderson, Ph.D. (Pennsylvania); William Dwight Billings, Ph.D. (Duke); *James B. Duke Professor of Botany*; William Lewis Culberson, Ph.D. (Wisconsin); Henry Hellmers, Ph.D. (California at Berkeley); Terry W. Johnson, Ph.D. (Michigan); Aubrey Willard Naylor, Ph.D. (Chicago), *James B. Duke Professor of Botany*; Jane Philpott, Ph.D. (State Univ. of Iowa); Donald E. Stone, Ph.D. (California at Berkeley); Richard A. White, Ph.D. (Michigan); Robert L. Wilbur, Ph.D. (Michigan), *Chairman*.

#### Associate Professors

Janis Antonovics, Ph.D. (Wales); Richard T. Barber, Ph.D. (Stanford); John E. Boynton, Ph.D. (California at Davis); Kenneth R. Knoerr, Ph.D. (Yale); Richard B. Searles, Ph.D. (California at Berkeley), *Director of Graduate Studies*; Boyd R. Strain, Ph.D. (California at Los Angeles).

\*On leave of absence.

### Assistant Professors

William F. Blankley, Ph.D. (California at San Diego); Norman L. Christensen, Jr., Ph.D. (California at Santa Barbara).

### Lecturer

C. F. Culberson, Ph.D. (Duke).

### Courses of Instruction

- |                                     |   |
|-------------------------------------|---|
| 202L. Phytoplankton Systematics     | 250L,S. Plant Biosystematics                                    |
| 203. Cytogenetics                   | 251L. Plant Physiology  |
| 203L. Cytogenetics                  | 252L. Plant Metabolism  |
| 204L. Marine Microbiology           | 256. Physiological Role of Minerals and Water                   |
| 206L. Anatomy of Woody Plants       | 257S. Principles of Plant Distribution                          |
| 207L. Microclimatology              | 258. Physiology of Growth and Development                       |
| 209L. Lichenology                   | 258L. Physiology of Growth and Development                      |
| 210L. Bryology                      | 259. The Environment  |
| 211L. Marine Phycology              | 260L. Plant Anatomy   |
| 212L. Phycology                     | 265L. Physiological Plant Ecology                               |
| 214L. Biological Oceanography       | 267L. Plant Community Ecology                                   |
| 217L. Environmental Instrumentation | 268L,S. Quantitative Plant Ecology                              |
| 221L. Mycology                      | 280. Principles of Genetics                                     |
| 225T, 226T. Special Problems        | 280L. Principles of Genetics                                    |
| 233L. Microbiology                  | 285S. Population Genetics                                       |
| 235. Evolutionary Systematics       | 286. Evolutionary Mechanisms                                    |
| 235L. Evolutionary Systematics      | 287S. Quantitative Genetics                                     |
| 236S. Major Global Ecosystems       | 295S, 296S. Seminar in Botany                                   |
| 242L. Systematics                   | 305. Tropical Studies   |
| 245L. Plant Diversity               | 344S. Advanced Topics in Micrometeorology<br>and Biometeorology |
| 246L. Ecology of Plants             | 359-360. Research in Botany                                     |
| 248. Introductory Biochemistry      |   |

## Business Administration

The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The program accepts students with bachelor's degree preparation and normally requires three to four years.

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

All 200-level courses in the Department of Management Sciences are open to graduate students from other departments. They are listed in the *Bulletin of Undergraduate Instruction*.

### Professors

Helmy Baligh, Ph.D. (California at Berkeley); Kalman J. Cohen, Ph.D. (Carnegie Inst. of Tech.); Thomas F. Keller, Ph.D. (Michigan); Arie Y. Lewin, Ph.D. (Carnegie-Mellon); David W. Peterson, Ph.D. (Stanford).

### Associate Professors

A. Rashad Abdel-Khalik, Ph.D. (Illinois); Kenneth R. Baker, Ph.D. (Cornell); Joseph Battle, Ph.D. (Michigan); Richard M. Burton, D.B.A. (Illinois); David C. Dellinger, Ph.D. (Stanford); Wayne J. Morse, Ph.D. (Michigan State).

### Assistant Professors

Carol Aldrich, Ph.D. (Carnegie-Mellon); William W. Damon, Ph.D. (Cornell); Jose A. Espejo, M.B.A. (Columbia); Arthur J. Kuhn, Ph.D. (California at Berkeley); Wesley A. Magat, Ph.D. (Northwestern); Steven F. Maier, Ph.D. (Stanford); James H. Scheiner, M.A. (Ohio State); Robert E.

Taylor, Ph.D. (North Carolina), James H. Vander Weide, Ph.D. (Northwestern) Robert A. Westbrook, Ph.D. (Michigan); Julie H. Zalkind, Ph.D. (John Hopkins).

### Courses of Instruction

- |   |  |
|---|--|
| 300. Managerial Economics I                             | 345. Legal Environment of the Firm                           |
| 301. Managerial Economics II                            | 346. Public Policy of the Firm                               |
| 309.1-9. Research in Managerial Economics               | 349.1-9. Research in Public Policy and Social Responsibility |
| 310. Mathematics for Management                         | 355. Financial Strategy                                      |
| 311. Statistical Analysis for Management Decisions      | 356. Finance   |
| 312. Operations Research                                | 359.1-9. Research in Finance                                 |
| 313. Advanced Operations Research                       | 365. Market Strategy   |
| 319.1-9. Research in Quantitative Methods               | 366. Marketing   |
| 320-321. Organization Theory and Management I, II       | 369.1-9. Research in Marketing                               |
| 329.1-9. Research in Organization Theory and Management | 375. Operations Strategy                                     |
| 330. Accounting Systems I                               | 376. Production  |
| 331. Accounting Systems II                              | 379.1-9. Research in Production                              |
| 333. Controllershship                                   | 381. Management of Financial Institutions                    |
| 334. External Reporting and Auditing                    | 382. Multinational Enterprise                                |
| 335. Management Information and Control Systems         | 385. Strategy of the Organization I                          |
| 339.1-9. Research in Information and Accounting Systems | 386. Strategy of the Organization II                         |
|   | 390. The Practicum   |
|   | 391.1-9. Special Topics in Management                        |
|   | 392-393. Tutorial in Interdisciplinary Areas                 |
|   | 397. Dissertation Research                                   |

## Chemistry

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

### Professors

Charles Kilgo Bradsher, Ph.D. (Harvard), *James B. Duke Professor of Chemistry*; Donald B. Chesnut, Ph.D. (California Inst. of Tech.), *Director of Graduate Studies*; Marcus Edwin Hobbs, Ph.D. (Duke); Peter W. Jeffis, Ph.D. (Natal); William R. Krigbaum, Ph.D. (Illinois); *James B. Duke Professor*; Andrew T. McPhail, Ph.D. (Glasgow); William E. Parham, Ph.D. (Illinois), *R. J. Reynolds Company Professor of Chemistry*; Jacques C. Poirier, Ph.D. (Chicago); Louis DuBose Quin, Ph.D. (North Carolina at Chapel Hill), *Chairman*; Peter Smith, Ph.D. (Cambridge); Howard Austin Strobel, Ph.D. (Brown); Richard L. Wells, Ph.D. (Indiana); Pelham Wilder, Jr., Ph.D. (Harvard).

### Associate Professors

Robert W. Henkens, Ph.D. (Yale); Charles H. Lochmüller, Ph.D. (Fordham); Richard A. Palmer, Ph.D. (Illinois); Ned Allen Porter, Ph.D. (Harvard).

### Assistant Professors

Roger W. Baier, Ph.D. (Washington); Steven Baldwin, Ph.D. (California Inst. of Tech.); Alvin L. Crumbliss, Ph.D. (Northwestern); William Gutknecht, Ph.D. (Purdue); Robert H. Neilson, Ph.D. (Duke); Joseph E. Sarneski, Ph.D. (Case Western Reserve); Barbara R. Shaw, Ph.D. (Washington).

### Adjunct Associate Professors

Robert G. Ghirardelli, Ph.D. (California Inst. of Tech.); Colin G. Pitt, Ph.D. (London); David Rosenthal, Ph.D. (Massachusetts Inst. of Tech.); Bernard F. Spielsvogel, Ph.D. (Michigan).

### Courses of Instruction

- |  |                                  |
|--|----------------------------------|
| 201. Molecular Spectroscopy                                  | 230. Environmental Oceanography  |
| 203. Quantum Chemistry                                       | 240. Chemical Oceanography       |
| 205. Structure and Reaction Dynamics                         | 275, 276. Advanced Studies       |
| 207. Principles of Thermodynamics, Diffraction, and Kinetics | 300. Basic Statistical Mechanics |
|  | 302. Basic Quantum Mechanics     |



- 303, 304. Special Topics in Physical Chemistry
- 310. Theoretical and Structural Inorganic Chemistry
- 312. Inorganic Reactions and Mechanisms
- 313, 314. Special Topics in Inorganic Chemistry
- 320. Synthetic Organic Chemistry
- 322. Organic Reactive Intermediates
- 323, 324. Special Topics in Organic Chemistry
- 330. Chemical Separation Methods and Kinetics in Analytical Chemistry
- 331, 332. Special Topics in Analytical Chemistry
- 334. Chemical Instrumentation and Applied Spectroscopy
- 373, 374. Seminar
- 375, 376. Research
- 377. Research Orientation Seminar

## Classical Studies

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of the official *Bulletin of the Graduate School* are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

### Professors

Francis Newton, Ph.D. (North Carolina at Chapel Hill), *Director of Graduate Studies*; John F. Oates, Ph.D. (Yale), *Chairman*; Lawrence Richardson, Jr., Ph.D. (Yale), F.A.A.R.; William H. Willis, Ph.D. (Yale).

### Associate Professor

Dennis Keith Stanley, Ph.D. (Johns Hopkins).

### Assistant Professors

Peter H. Burian, Ph.D. (Princeton); Kent J. Rigsby, Society of Fellows (Harvard).

### Visiting Lecturer

Harry L. Levy, Ph.D. (Columbia).

## GREEK

### Courses of Instruction

- 200. Graduate Reading
- 203. Homer
- 205. Greek Lyric Poets
- 206. Aeschylus
- 208. Sophocles
- 209. Euripides
- 210. Aristophanes
- 221. Early Greek Prose
- 222. Thucydides
- 223. Greek Orators I
- 224. Greek Orators II
- 225. Plato
- 231. Hellenistic Poetry
- 241. Advanced Prose Composition
- 301. Greek Seminar I
- 302. Greek Seminar II
- 303. Greek Seminar III
- 304. Greek Seminar IV
- 305. Greek Seminar V
- 306. Greek Seminar VI
- 311. Proseminar in Papyrology
- 313. Proseminar in Greek Epigraphy
- 321. Seminar in Literary Papyri
- 323. Seminar in Documentary Papyri
- 399. Directed Reading and Research

## LATIN

- 200. Graduate Reading
- 201. The Verse Treatise
- 202. Roman Satire
- 203. Epic: Vergil
- 204. Epic: Lucan and Statius
- 207. The Prose Epistle

- 208. The Epistle in Verse
- 209. Fragments of Early Latin
- 210. Lyric and Occasional Poetry
- 211. Roman Oratory I
- 212. Roman Oratory II
- 221. Medieval Latin I
- 222. Medieval Latin II
- 225. Latin Paleography
- 241. Advanced Latin Composition
- 250. Teaching Latin

- 301. Latin Seminar I
- 302. Latin Seminar II
- 303. Latin Seminar III
- 304. Latin Seminar IV
- 305. Latin Seminar V
- 306. Latin Seminar VI
- 312. Proseminar in Latin Paleography
- 314. Proseminar in Latin Epigraphy
- 315. Proseminar in Roman Law
- 399. Directed Reading and Research

## CLASSICAL STUDIES

- 301. Introduction to Classical Philology
- 351. The Teaching of Classics

## CLASSICAL STUDIES (ANCIENT HISTORY)

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>253. Greece to the Orientalizing Period</li> <li>254. The Age of the Tyrants and the Persian Wars</li> <li>255. The Age of Pericles</li> <li>256. The Fourth Century through Alexander</li> <li>257. Social and Cultural History of the Hellenistic World from Alexander to Augustus</li> <li>258. Social and Cultural History of the Graeco-Roman World</li> <li>260. The History of Rome to 146 B.C.</li> <li>261. The Roman Revolution, 146-30 B.C.</li> <li>262. Rome under the Julio-Claudians</li> </ul> | <ul style="list-style-type: none"> <li>263. From the Flavian Dynasty to the Severan</li> <li>264. From Septimius Severus to Constantine</li> <li>270. The Rise of the Hellenistic Kingdoms</li> <li>271. The Hellenistic World, 250-31 B.C.</li> <li>321. Seminar in Ancient History I</li> <li>322. Seminar in Ancient History II</li> <li>323. Seminar in Ancient History III</li> <li>324. Seminar in Ancient History IV</li> <li>325. Seminar in Ancient History V</li> <li>326. Seminar in Ancient History VI</li> <li>327. Seminar in Byzantine History</li> <li>399. Directed Reading and Research</li> </ul> |
|---|--|

## CLASSICAL STUDIES (ARCHEOLOGY)

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>231. Greek Sculpture</li> <li>232. Greek Painting</li> <li>235. Roman Architecture</li> </ul> | <ul style="list-style-type: none"> <li>236. Roman Painting</li> <li>311. Archeology Seminar I</li> <li>312. Archeology Seminar II</li> </ul> |
|--|--|

## Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Wardropper in the Department of Romance Languages.

### Courses of Instruction

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>201, 202. Romanticism</li> <li>203, 204. Realism and Symbolism</li> <li>205. The Modern: Problems of Definition, History, and Language</li> <li>206. Autobiography</li> </ul> | <ul style="list-style-type: none"> <li>220S. Comparative Literature Seminar</li> <li>223. Structuralism and the New Criticism</li> <li>285. Literary Criticism</li> <li>301. The Hero in European Fiction, 1830-1940</li> </ul> |
|--|---|

## Computer Sciences

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and of at least two computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, programming languages, real-time computing, operating systems, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

### Professors

Thomas M. Gallie, Ph.D. (Rice); Donald W. Loveland, Ph.D. (New York Univ.), *Chairman*; Peter N. Marinos, Ph.D. (North Carolina State); Thomas H. Naylor, Ph.D. (Tulane); Loren Noite, Ph.D. (Michigan); Max A. Woodbury, Ph.D. (Michigan).

## Associate Professors

William E. Hammond, Ph.D. (Duke); Merrell L. Patrick, Ph.D. (Carnegie Inst. of Tech.), Charles Starmer, Ph.D. (North Carolina at Chapel Hill).

## Assistant Professors

Alan W. Biermann, Ph.D. (California at Berkeley); Derrell V. Foster, Ph.D. (Texas at Austin); Susan L. Gerhart, Ph.D. (Carnegie-Mellon), *Director of Graduate Studies*; Dietolf Ramm, Ph.D. (Duke); Kishor S. Trivedi, Ph.D. (Illinois).

## Adjunct Associate Professor

Leland Williams, Ph.D. (Duke).

## Courses of Instruction

- |  |  |
|--|--|
| 200. Programming Methodology                         | 250. Pattern Analysis, Clustering and Typology     |
| 201. Programming Languages                           | 251. Computer Science for Teachers                 |
| 203. Random Signals and Noise                        | 265. Advanced Topics in Computer Science           |
| 205. Signal Detection and Extraction Theory          | 301. Topics in Programming Theory                  |
| 208. Digital Computer Design                         | 306. Adaptive Detection and Communication Systems  |
| 210. Image Processing                                | 307. Advanced Digital Systems I                    |
| 215. Artificial Intelligence                         | 308. Advanced Digital Systems II                   |
| 221. Numerical Analysis I                            | 311. Inverse Models                                |
| 222. Numerical Analysis II                           | 315. Advanced Artificial Intelligence              |
| 223. Numerical Optimization                          | 321. Topics in Numerical Mathematics               |
| 225. Mathematical Foundations of Computer Science I  | 325. Theory of Computation                         |
| 226. Mathematical Foundations of Computer Science II | 326. Systems Modeling                              |
| 231. Introduction to Operating Systems               | 331. Operating Systems Theory                      |
| 232. Metaprograms                                    | 332. Topics in Operating Systems                   |
| 241, 242. Information Organization and Retrieval     | 344. Workshop on Computer Models of Social Systems |
| 244. Computer Simulation Models of Economic Systems  | 350. Advanced Engineering Analysis                 |

## Economics

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include examination in economic theory at the end of the first year, and, at the end of the second year, an examination in economic analysis. In addition, a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g., demography). Course work for the Ph.D. degree should be completed in four semesters of residence.

## Professors

John Oliver Blackburn, Ph.D. (Florida); Martin Bronfenbrenner, Ph.D. (Chicago), *William R. Kenan, Jr. Professor of Economics*; David George Davies, Ph.D. (California at Los Angeles); Craufurd David Goodwin, Ph.D. (Duke); Allen C. Kelley, Ph.D. (Stanford), *Chairman*; Juanita Morris Kreps, Ph.D. (Duke), *James B. Duke Professor of Economics*; Harold Gregg Lewis, Ph.D. (Chicago); Thomas Herbert Naylor, Ph.D. (Tulane); Lloyd Blackstone Saville, Ph.D. (Columbia); Vladimir G. Trembl, Ph.D. (North Carolina at Chapel Hill); John M. Vernon, Ph.D. (Massachusetts Inst. of Tech.); Thomas D. Wallace, Ph.D. (Chicago); William Poe Yohe, Ph.D. (Michigan).

## Associate Professors

Neil de Marchi, Ph.D. (Australian National Univ.), Henry Grabowski, Ph.D. (Princeton); Daniel

A. Graham, Ph.D. (Duke), Thomas M. Havrilesky, Ph.D. (Illinois); Edward Tower, Ph.D. (Harvard), Eliot Roy Weintraub, Ph.D. (Pennsylvania), *Director of Graduate Studies*.

### Assistant Professors

Bruce R. Bolnick, Ph.D. (Yale); Marjorie McElroy, Ph.D. (Northwestern); Allen M. Wyse, Ph.D. (Illinois).

### Courses of Instruction

- |   |   |
|---|---|
| 200. Capitalism and Socialism                             | 317. Seminar in Demographic, Population, and Resource Problems            |
| 204S. Advanced Money and Banking                          | 318. Dissertation Seminar   |
| 231S. Economic Development of Europe                      | 319. Seminar in the Theory and the Problems of Economic Growth and Change |
| 232. Economic History of Japan                            | 320. Macroeconomic Analysis I   |
| *233. State and Urban Finance                             | 321. Theory of Quantitative Economic Policy                               |
| 234. Urban Economics                                      | 322. Macroeconomic Analysis II  |
| 235. The Economics of Crime, Law Enforcement, and Justice | 323. Income Distribution Theory   |
| 237, 238. Statistical Methods                             | 329. Federal Finance  |
| 243. Econometrics I                                       | 330. Seminar in Public Finance  |
| 244. Computer Simulation Models of Economic Systems       | 331. Seminar in Economic History  |
| 245. Econometrics II                                      | 344. Workshop on Computer Models of Social Systems                        |
| 262. Trade Unionism and Collective Bargaining             | 345, 346. Demographic Techniques I and II                                 |
| 265S. International Trade and Finance                     | 350. Seminar in Applied Economics   |
| 287. Public Finance                                       | 355. Seminar in Labor Economics   |
| 293. Soviet Economic History                              | 358. Seminar in Labor Market and Related Analysis                         |
| 294S. Soviet Economic System                              | 365. Seminar in International Economics                                   |
| 301. Microeconomic Analysis I                             | 366. Monetary Aspects of International Trade and Finance                  |
| 302. Microeconomic Analysis II                            | *388. Industrial Organization   |
| 303. Theory of Economic Decision-Making                   | *389. Seminar in Industrial and Governmental Problems                     |
| 304, 305. Monetary Theory and Policy                      | 397, 398. Directed Research   |
| 307. Quantitative Analysis I                              | 401. Seminar on the British Commonwealth                                  |
| 308. Quantitative Analysis II                             | 402. Interdisciplinary Seminar in the History of the Social Sciences      |
| 311, 312. History of Political Economy                    |   |
| 313, 314. Seminar in Economic Theory                      |   |
| 316. Seminar in Economics of Soviet-Type Socialism        |   |

## Education

Graduate work in education is offered leading to the A.M., the M.Ed., the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in the official *Bulletin of the Graduate School*. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the *Bulletin of the Summer Session*.)

These programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

### Professors

Anne H. Adams, Ed.D. (Mississippi); William H. Cartwright, Ph.D. (Minnesota); Anne Flowers, Ed.D. (Duke), *Chairman*; W. Scott Gehman, Jr., Ph.D. (Pennsylvania State); Sherwood Githens, Jr., Ph.D. (North Carolina at Chapel Hill); Everett H. Hopkins, M.A. (Wittenburg), *Director of Cooperative Programs*; Allan S. Hurlburt, Ph.D. (Cornell); William G. Katzenmeyer, Ed.D. (Duke); Olan Lee Petty, Ph.D. (Iowa); *Director of Graduate Studies*; R. Baird Shuman, Ph.D. (Pennsylvania); Henry Weitz, Ed.D. (Rutgers).

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\*Offered on demand



## Associate Professors

Robert H. Ballantyne, Ed.D. (Washington State); Peter F. Carbone, Ed.D. (Harvard); Robert Merle Colver, Ed.D. (Kansas); Lucy T. Davis, Ed.D. (Columbia); Joseph DiBona, Ph.D. (California at Berkeley); Charles B. Johnson, Ed.D. (Duke); David V. Martin, Ed.D. (Duke); Robert A. Pittillo, Jr., Ed.D. (Duke).

## Lecturers

John A. Fowler, M.D. (Bowman Gray); Illa Gehman, Ed.D. (Pennsylvania State); Richard H. Leach, Ph.D. (Princeton).

## Courses of Instruction

- |   |  |
|---|--|
| 201. Mathematics Program in the Elementary School                               | 247. Practicum in Guidance and Counseling                          |
| 202. Comparative and International Education: Industrialized Nations            | 248. Practicum in Counseling                                       |
| 203. Seminar in Philosophical Analysis of Educational Concepts                  | 249. Exceptional Children  |
| 204. Educational Organization   | 250, 251. Teaching Emotionally Disturbed Children: Internship      |
| 206. Studies in the History of Educational Philosophy                           | 253. Introduction to Law and Education                             |
| 207. Social History of Twentieth Century American Education                     | 254. Law and Higher Education                                      |
| 209S. John Dewey  | 255. Assessment of Abilities                                       |
| 210. The Politics of Education  | 256. Classroom Assessment of Student Achievement                   |
| 213. Elementary School Organization and Administration                          | 258. Assessment of Personality, Interests, and Attitudes           |
| 215S. Secondary Education: Principles   | 259. Problems in Law and Education                                 |
| 216. Secondary Education: Internship  | 260. Educational Research I  |
| 217. The Psychological Principles of Education                                  | 261. Educational Research II                                       |
| 218. Comparative and International Education: Developing Societies              | 262. Educational Research III                                      |
| 219. Comparative and International Education: South Asia                        | 266. Basic Science for Teachers                                    |
| 221. Programs in Early Childhood Education                                      | 268. Seminar in Contemporary Educational Criticism                 |
| 222. New Developments in Elementary School Curriculum                           | 270. Junior and Community College                                  |
| 223. Teaching the Language Arts   | 271. Teaching in the Junior and Community Colleges                 |
| 224. Teaching the Social Studies in Elementary Schools                          | 272. Teaching Communication Skills in Early Childhood Education    |
| 225. The Teaching of History and the Social Studies                             | 273, 274. Clinical Reading Practicum                               |
| 226. Teaching Developmental and Remedial Reading in the Elementary School       | 276. The Teaching of High School Science                           |
| 227. The Teaching of Geography  | 285. Audiovisual Aids in Education                                 |
| 229. Assessments of Reading Disability Cases                                    | 291. Public and Community Relations of Schools                     |
| 232. Psycho-educational Counseling with Parents                                 | 300. Individual Assessment of Intelligence                         |
| 233. Improvement of Instruction in English                                      | 301. Advanced Individual Assessment of Cognitive Abilities         |
| 234. Secondary School Organization and Administration                           | 302. Seminar in Educational Research                               |
| 236. Teaching Developmental and Remedial Reading in the Secondary School        | 303. Diagnostic and Educational Programs in Learning Disabilities  |
| 237. Teaching of Literature in Secondary Schools                                | 304. Internship in School Psychology                               |
| 238. Content, Supervision, and Administration of Reading Programs               | 309. Seminar on Higher Education in the United States              |
| 239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School | 310. Seminar in Higher Educational Administration                  |
| 240. Career Development   | 311. Group Counseling  |
| 241. Foundations of Counseling and Personnel Services                           | 313. Seminar in Education and Public Policy                        |
| 243. Personality Dynamics   | 314. Seminar in Guidance and Counseling                            |
| 244. Counseling Techniques  | 315. Seminar in Secondary School Teaching                          |
| 245. Theories of Counseling   | 316, 317. Practicum in Higher Educational Research and Development |
| 246. Teaching of Mathematics  | 321. Educational Management  |
|   | 322. Planning and Management of Educational Facilities             |
|   | 323. Public School Finance   |
|   | 326. Educational Psychology: The Problem Child                     |
|   | 332. Supervision of Instruction                                    |
|   | 335, 336. Seminar in School Administration                         |
|   | 337. Seminar in Community College Organization                     |

- 338. Seminar in Educational Supervision
- 339. Seminar in Curriculum
- 340. Seminar in Social Studies Curriculum
- 341. Seminar in Elementary School Curriculum
- 342. Seminar in Secondary School Curriculum
- 343. History of Higher Education in America
- 344. Research in Higher Education
- 345. Seminar in Reading Instruction and Research

- 346. Seminar in Organization of Pre-Service and In-Service Reading Programs
- 347. Student Personnel Services in Higher Education
- 348, 349. Seminar in Child Psychopathology
- 350, 351. Directed Activities in Education
- 360. Seminar on Instructional Strategies

## Engineering

Aleksandar Sedmak Vesić, D.Sc., *Dean* (136 Engineering).

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the physical sciences, and to develop experience in the art of engineering, which includes strong elements of intuition, imagination, and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A non-thesis option requiring 30 units of course credit is available. Each of the departments imposes requirements in the exercise of this option. There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation. In mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

### BIOMEDICAL ENGINEERING

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics; biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

#### Professors

Howard G. Clark, Ph.D. (Maryland); James M. McElhaney, Ph.D. (West Virginia); Loren Nolte, Ph.D. (Michigan); Theo Clyde Pilkington, Ph.D. (Duke), *Chairman*; Frederick L. Thurstone, Ph.D. (North Carolina State), *Director of Graduate Studies*; Myron Wolbarsht, Ph.D. (Johns Hopkins).

#### Associate Professors

Roger Barr, Ph.D. (Duke); Evan A. Evans, Ph.D. (California at San Diego); William E. Hammond, Ph.D. (Duke); Howard C. Wachtel, Ph.D. (New York Univ.).

#### Assistant Professors

H. Dennis Tolley, Ph.D. (North Carolina at Chapel Hill); Olaf T. von Ramm, Ph.D. (Duke).

### Courses of Instruction

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|--|--|
| 201. Analysis of Bioelectric Phenomena                 | 241, 242. Information Organization and Retrieval |
| 202. Energy and Rate in Biological Processes           | 243. Computers in Biomedical Engineering         |
| 203. Bioelectric Potentials and Field Theory           | 252. Marine Electrobiolgy                        |
| 204. Real Time Measurement and Control of Heart Events | 265. Advanced Topics in Biomedical Engineering   |
| 207. Experimental Mechanics                            | 311. Inverse Models                              |
| 223. Biomedical Materials and Artificial Organs        | 333. Biomedical Imaging                          |
| 225. Mechanics of Cellular Components                  | 399. Special Readings in Biomedical Engineering  |
| 230. Biomechanics                                      |  |
| 233. Discrete Systems and Models of Computation        |  |

### CIVIL ENGINEERING

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the A.M. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If the candidate elects this alternative, he is expected to take a comprehensive examination over his graduate course work, and also to defend orally his special project.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

### Professors

Earl I. Brown, Ph.D. (Texas), *J. A. Jones Professor of Civil Engineering*; J. Dvorak, Ph.D. (Brown); Bruce J. Muga, Ph.D. (Illinois), *Chairman and Director of Graduate Studies*; Senol Utku, Sc.D. (Massachusetts Inst. of Tech.); Aleksandar Sedmak Vesic, D.Sc. (Belgrade), *J. A. Jones Professor of Civil Engineering*.

### Associate Professors

Jarir Dajani, Ph.D. (Northwestern); Aubrey E. Palmer, C.E. (Virginia); P. Aarne Vesilind, Ph.D. (North Carolina at Chapel Hill); James F. Wilson, Ph.D. (Ohio State).

### Assistant Professor

Yuet Tsui, Ph.D. (Duke).

### Adjunct Professor

Edward A. Saibel, Ph.D. (Massachusetts Inst. of Tech.).

### Adjunct Assistant Professor

Dennis Warner, Ph.D. (Stanford).

### Lecturers

George T. Lathrop, M.C.P. (Yale); Alan E. Rimer, M.S. (North Carolina at Chapel Hill).

### Courses of Instruction

- |                                   |                        |
|-----------------------------------|------------------------|
| 201. Advanced Mechanics of Solids | 204. Plates and Shells |
|-----------------------------------|------------------------|

205. Elasticity
206. Advanced Mechanics of Solids II
209. Structural Dynamics
210. Intermediate Dynamics
212. Mechanical Behavior of Materials
215. Urban and Regional Geography
216. Transportation Planning and Policy Analysis
217. Transportation Systems Analysis
218. Engineering-Economic Analysis
221. Incompressible Fluid Flow
222. Open Channel Flow
223. Flow Through Porous Media
224. Coastal and Offshore Engineering
225. Engineering Hydrology
231. Structural Engineering Analysis
232. Reinforced Concrete Design
233. Prestressed Concrete Design
234. Structural Design in Metals
235. Foundation Engineering
236. Earth Structures
238. Rock Mechanics
241. Environmental Engineering Chemistry and Biology
- 243, 244. Sanitary Engineering Unit Operations and Process Design
246. Sanitary Engineering Design
247. Air Pollution Control
248. Solid Waste and Resource Recovery Engineering
249. Resource Recovery Systems Management
250. Engineering Analysis
251. Systematic Structural Analysis I
252. Systematic Structural Analysis II
306. Plasticity
331. Special Problems of Systematic Analysis
335. Mechanical Behavior of Soils
336. Advanced Soil Mechanics
337. Elements of Soil Dynamics
350. Advanced Engineering Analysis
365. Advanced Topics in Civil Engineering
399. Special Readings in Civil Engineering

## ELECTRICAL ENGINEERING

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; super-conducting circuits; instrumentation; electronics; microwaves; automatic control; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electromagnetic theory, and network analysis. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

### Professors

John Leslie Artley, D.Eng. (Johns Hopkins); Robert Blackburn Kerr, D.Eng. (Johns Hopkins); Peter N. Marinos, Ph.D. (North Carolina State), *Director of Graduate Studies*; Loren W. Nolte, Ph.D. (Michigan); Harry Ashton Owen, Jr., Ph.D. (North Carolina State); Theo Clyde Pilkington, Ph.D. (Duke); Frederick L. Thurstone, Ph.D. (North Carolina State); Paul P. Wang, Ph.D. (Ohio State); Thomas George Wilson, Sc.D. (Harvard).

### Associate Professors

Herbert Hacker, Ph.D. (Michigan), *Chairman*, William Thomas Joines, Ph.D. (Duke).

### Assistant Professor

Rhett Truesdale George, Ph.D. (Florida).

### Courses of Instruction

203. Random Signals and Noise
204. Information Theory and Communication Systems
205. Signal Detection and Extraction Theory
206. Digital Signal Processing
208. Digital Computer Design
211. Solid State Theory
212. Solid State Materials
213. Principles of Magnetism
215. Semiconductor Physics
217. Masers
221. Nonlinear Networks and Systems
222. Nonlinear Analysis
224. Integrated Electronics: Analog and Digital
225. Semiconductor Electronic Circuits
227. Network Synthesis
241. Linear Systems
242. Modern Control and Dynamic Systems
243. Advanced Linear Systems Theory
251. Pattern Classification and Recognition
265. Advanced Topics in Electrical Engineering
266. Biofeedback Systems
271. Electromagnetic Theory



- 272. Application of Electromagnetic Theory
- 297-298. Thesis Research
- 304. Estimation, Filtering, and Random Systems
- 305. Advanced Applications of Statistical Decision Theory
- 306. Adaptive Detection and Communication Systems
- 307. Advanced Digital Systems I
- 308. Advanced Digital Systems II
- \*313. Magnetic Processes in Materials
- 321. Nonlinear Magnetic and Semiconductor Circuits
- 324. Nonlinear Oscillations in Physical Systems
- 342. Optimal Control Theory
- \*371. Advanced Electromagnetic Theory
- \*373. Selected Topics in Field Theory
- 399. Special Readings in Electrical Engineering

## MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in either mechanical engineering or materials science. Departmental programs of advanced study and research include control systems, dynamics and vibrations, energy conversion, fluid mechanics, heat and mass transport, mechanical design, thermodynamics, physical metallurgy, corrosion, fracture, and polymer science. The faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. A major emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

### Professors

Jack Bartley Chaddock, Sc.D. (Massachusetts Inst. of Tech.), *Chairman*; Howard G. Clark, Ph.D. (Maryland); Devendra P. Garg, Ph.D. (New York Univ.); Charles Morgan Harman, Ph.D. (Wisconsin); George Wilbur Pearsall, Sc.D. (Massachusetts Inst. of Tech.).

### Associate Professors

Franklin H. Cocks, Ph.D. (Massachusetts Inst. of Tech.); Ernest Elsevier, M.S.M.E. (Georgia Inst. of Tech.); Marion LaVerne Shepard, Ph.D. (Iowa State); Donald Wright, Ph.D. (Purdue).

### Assistant Professors

Gale Herbert Buzzard, Ph.D. (North Carolina State), *Director of Graduate Studies*; Charles E. Johnson, Ph.D. (Duke); Edward Shaughnessy, Jr., Ph.D. (Virginia).

### Adjunct Professor

Verne L. Roberts, Ph.D. (Illinois).

### Adjunct Associate Professor

George Mayer, Ph.D. (Massachusetts Inst. of Tech.).

### Courses of Instruction

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| <ul style="list-style-type: none"> <li>202. Theoretical Thermodynamics</li> <li>209. Structural Dynamics</li> <li>210. Intermediate Dynamics</li> <li>211. Theoretical and Applied Polymer Science</li> <li>213. Advanced Materials Science</li> <li>214. Corrosion and Corrosion Control</li> <li>215. Failure Analysis and Prevention</li> <li>216. Materials Design and Resource Conservation</li> <li>221. Compressible Fluid Flow</li> <li>222. Heat Transfer</li> <li>224. An Introduction to Turbulence</li> <li>226. Intermediate Fluid Mechanics</li> <li>230. Modern Control and Dynamic Systems</li> <li>231. Systems Response and Control</li> </ul> | <ul style="list-style-type: none"> <li>232. Nonlinear Analysis</li> <li>233. Fluid Control Systems</li> <li>235. Advanced Mechanical Vibrations</li> <li>236. Engineering Acoustics and Noise Control</li> <li>251. Refrigeration and Cryogenics</li> <li>255. Energy Conversion</li> <li>265. Advanced Topics in Mechanical Engineering</li> <li>270. Theory of Lubrication and Bearing Design</li> <li>280. Nuclear Reactor Power Cycles</li> <li>300. Advanced Projects in Mechanical Engineering</li> <li>302. Advanced Thermodynamics</li> <li>311. Behavior of Crystalline Solids</li> <li>321. Mechanics of Viscous Fluids</li> </ul> |
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\*Offered on demand.

- 323. Convective Heat Transfer
- 324. Conduction and Radiation Heat Transfer
- 327. Homogeneous Turbulence
- 328. Turbulent Shear Flow
- 331. Nonlinear Control Systems
- 333. Seminar in Control Systems
- 335. Analytical Methods in Vibrations
- 372. Finite Element Techniques in Design
- 399. Special Readings in Mechanical Engineering

## English

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.

### Professors

Carl Anderson, Ph.D. (Pennsylvania); Louis J. Budd, Ph.D. (Wisconsin), *Chairman*; Edwin H. Cady, Ph.D. (Wisconsin); Bernard I. Duffy, Ph.D. (Ohio State); Oliver W. Ferguson, Ph.D. (Illinois); Holger O. V. Nygard, Ph.D. (California), *Director of Graduate Studies*; Dale B. J. Randall, Ph.D. (Pennsylvania); Edmund Reiss, Ph.D. (Harvard); Clyde de Loache Ryals, Ph.D. (Pennsylvania); Grover C. Smith, Ph.D. (Columbia); Arlin Turner, Ph.D. (Texas); George W. Williams, Ph.D. (Virginia).

### Associate Professors

Ronald Richard Butters, Ph.D. (Iowa); A. Leigh DeNeef, Ph.D. (Pennsylvania State); Gerald E. Gerber, Ph.D. (Northwestern); Wallace Jackson, Ph.D. (Pennsylvania); Buford Jones, Ph.D. (Harvard); Elgin Mellow, Ph.D. (London); Gerald Monsman, Ph.D. (Johns Hopkins); Victor H. Strandberg, Ph.D. (Brown).

### Courses of Instruction

- 207. Old English Grammar and Readings
- 208. History of the English Language
- 209. Present-Day English
- 210. Old English Literary Tradition
- 212. Middle English Literary Tradition
- 215, 216. Chaucer
- 221. English Prose of the Sixteenth Century
- 222. English Non-Dramatic Poetry of the Sixteenth Century
- 223. Spenser
- 224. Shakespeare
- 225, 226. Tudor and Stuart Drama, 1500-1642
- 229, 230. English Literature of the Seventeenth Century
- 232. Milton
- 234. English Drama, 1642-1800
- 235, 236. The Eighteenth Century
- 241, 242. English Literature of the Early Nineteenth Century
- 245, 246. English Literature of the Later Nineteenth Century
- 251, 252. English Literature of the Twentieth Century
- 263, 264. American Literature, 1800-1865
- 267, 268. American Literature, 1865-1915
- 270, 271. Southern Literature
- 275, 276. American Literature since 1915
- 280. Introduction to Folklore
- 285. Literary Criticism
- 287. Recent Critical Thought
- 289. Literary Biography
- 310. Beowulf
- 312. Studies in Middle English Literature
- 315. Studies in Chaucer
- 318. Medieval Romances
- 320. Studies in Renaissance English Prose
- 324. Studies in Shakespeare
- 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries
- 329. Studies in the Metaphysical Poets
- 330. Studies in Dryden and His Age
- 337. Studies in Swift
- 338. Samuel Johnson's Literary Criticism and Related Topics
- 339. The Eighteenth Century Novel
- 341. Studies in English Romanticism
- 343. Studies in Coleridge and Carlyle
- 347. Studies in Victorian Poetry
- 348. Studies in Victorian Fiction
- 349. Studies in Nineteenth Century Non-fictional Prose
- 353. Studies in British Poetry of the Twentieth Century
- 354. Studies in British Prose of the Twentieth Century
- 361. Studies in a Major American Author of the Early Nineteenth Century
- 362. Studies in a Major American Author of the Later Nineteenth Century
- 364. Hawthorne and Melville
- 368. Studies in American Realistic Fiction
- 369. Studies in American Humor
- 376. Studies in Twentieth Century American Literature
- 380. The Traditional Ballad and Folksong
- 383. Textual Criticism
- 387. Special Topics Seminar
- 100. English for Foreign Students

# Forestry and Environmental Studies

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the *Bulletin of the School of Forestry and Environmental Studies* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the A.M. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree.

## Professors

Roger Fabian Anderson, Ph.D. (Minnesota), *Director of Graduate Studies*; Robert Lloyd Barnes, Ph.D. (Duke); Henry Hellmers, Ph.D. (California at Berkeley); Kenneth Richard Knoerr, Ph.D. (Yale); Jane Philpott, Ph.D. (State Univ. of Iowa); Charles William Ralston, Ph.D. (Duke), *Dean of the School of Forestry*; William James Stambaugh, Ph.D. (Yale).

## Associate Professors

Jarir S. Dajani, Ph.D. (Northwestern); Aarne P. Vesilind, Ph.D. (North Carolina at Chapel Hill); David O. Yandle, Ph.D. (North Carolina State).

## Adjunct Associate Professors

Edgar W. Clark, Ph.D. (California at Berkeley); Milton S. Heath, Jr., LL.B. (Columbia); Charles S. Hodges, Jr., Ph.D. (Georgia); Louis John Metz, Ph.D. (Duke); Fred M. Vukovich, Ph.D. (St. Louis).

## Assistant Professors

Frank J. Convery, Ph.D. (State University of New York); R. Rajagopal, Ph.D. (Michigan); James E. Wuenscher, Ph.D. (Wisconsin).

## BIOLOGICAL SCIENCE

### Courses of Instruction

#### *Dendrology and Wood Anatomy*

- 206F. Anatomy of Woody Plants
- 241F. Dendrology
- 292F. Microtechnique of Woody Tissue

#### *Ecology*

- 243E.S. Natural Resource Ecology
- 277F. Seminar in Natural Resource Allocation and Efficiency
- 337E.S. Ecological Analysis for Environmental Management
- 340E.S. Ecology and Land Use Planning
- 341E.S. Ecological Principles in Environmental Management
- 346E.S. Seminar in Environmental Policy
- 347E.S., 348E.S. Natural Resource Ecology—Environmental Management Seminar
- 349E.S. Wildland and Wildlife Management
- 354E.S. Biological and Resource System Simulation

#### *Entomology*

- 222F. Biology of Forest Insects and Diseases

- 225F. Chemical Aspects of Forest Protection
- 230F. Forest Entomology
- 233F. General Entomology
- 331F. Toxicology of Insecticides
- 332F. Ecology of Forest Insects
- 335F. Entomological Research Techniques
- 385F. Seminar in Forest Protection

#### *Pathology*

- 222F. Biology of Forest Insects and Diseases
- 223F. Forest Pathology
- 225F. Chemical Aspects of Forest Protection
- 321F. Phytopathological Technique in Forestry
- 322F. Microbiology of Forest Soils
- 385F. Seminar in Forest Protection

#### *Physiology and Biochemistry*

- 205F. Tree Growth and Development
- 207F. Chemistry of Woody Tissues
- 208F. Physiology of Wood Formation
- 225F. Chemical Aspects of Forest Protection
- 305F. Forest Biochemistry

## ENVIRONMENTAL SCIENCE

### Soils

- 261F. Forest Soils
- 362F. Forest Soil Physics
- 364F. Soil Classification and Mapping
- 366F. Forest Soil Fertility

### Meteorology

- 203F. General Meteorology
- 204F. Microclimatology
- 215F. Air Pollution Meteorology

### 217F. Environmental Instrumentation

- \*304F. Atmospheric Turbulence and Diffusion
- \*306F. Dynamics of Local Atmospheric Motion
- \*344F. Micrometeorology and Biometeorology Seminar

### Hydrology

- 216F. Watershed Hydrology
- \*342F. Hydrologic Processes

## RESOURCE ECONOMICS AND POLICY

- 269F. Resource Economics and Policy
- 270F. Economics of Forestry
- 273E.S. Economics and Environmental Quality

- 277F. Seminar in Natural Resource Allocation and Efficiency
- 378F. Seminar in Forest Economics

## STATISTICS AND OPERATIONS RESEARCH

- 250F. Biometry
- 251F. Theory and Methods for Sampling Biological Populations
- 253F. Computer Science in Natural Resources

- 258F. Quantitative Analysis in Resource Management
- 354E.S. Biological and Resource System Simulation

## SPECIAL STUDIES AND RESEARCH

- 299F. Special Studies in Forestry
- 299E.S. Independent Projects in Environmental Studies
- 301F, 302F. Advanced Studies in Forestry

- 301E.S., 302E.S. Advanced Projects in Environmental Studies
- 357F, 358F. Research in Forestry
- 368F. Field Seminars

## The University Program in Genetics

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151).

### Professors

D. Bernard Amos, M.D. (Guys Hospital, London); Nicholas Gillham, Ph.D. (Harvard); Samson R. Gross, Ph.D. (Columbia), *Director*; Walter R. Guild, Ph.D. (Yale).

### Associate Professors

Janis Antonovics, Ph.D. (Wales); John E. Boynton, Ph.D. (California at Davis); Sheila J. Counce, Ph.D. (Edinburgh); Calvin L. Ward, Ph.D. (Texas); Frances E. Ward, Ph.D. (Brown); Robert E. Webster, Ph.D. (Duke).

### Assistant Professors

Dwight H. Hall, Ph.D. (Purdue); Nicholas Kredich, M.D. (Michigan).

### Courses of Instruction

- 204. Introductory Genetics
- 216. Molecular Genetics
- 280. Principles of Genetics

- 282. Experimental Genetics
- 284. Current Topics in Genetic Mechanisms
- 285. Population Genetics

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\*Offered on demand.



286. Evolutionary Mechanisms  
287. Quantitative Genetics  
288. Seminar on the Role of the Cell in Development and Heredity
336. Immunogenetics  
351-352. Genetics Seminar

Geology

The Department of Geology offers graduate work leading to the M.S. and Ph.D. degrees. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition, he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

The Ph.D. degree is available through the Earth Science Consortium, a new inter-university doctoral program combining the faculties and research facilities of Duke, Emory, and Tulane Universities. The Earth Science Consortium offers specialization in the areas of paleontology, sedimentology, stratigraphy, marine geology, environmental geology, and regional geology. Under this program, a student admitted to Duke University would be expected to spend one year of study at another of the participating universities. Such a program offers the student a broadly-based faculty with diverse research interests and the opportunity to pursue graduate education in a variety of geologic settings. Normally, a candidate would hold the master's degree at the time of admission to the program. Additional information concerning the details of the doctoral program is available on request.

Professors

S. Duncan Heron, Jr., Ph.D. (North Carolina at Chapel Hill), *Chairman*; Orrin H. Pilkey, Ph.D. (Florida State).

Associate Professors

William J. Furbish, M.S. (Wisconsin); George W. Lynts, Ph.D. (Wisconsin); Ronald D. Perkins, Ph.D. (Indiana), *Director of Graduate Studies*.

Visiting Professor

Richard M. Pratt, Ph.D. (Washington Univ.).

Courses of Instruction

205. Geological Oceanography  
206S. Principles of Geological Oceanography  
208. Shallow-Marine Geology  
211S. Stratigraphic Principles and Application  
212. Facies Analysis  
213. Sedimentology  
214S. Sediments in Thin Section  
222. Sedimentary Minerals  
229. Economic Geology  
230. Principles of Structural Geology  
233. Geochemistry  
241-242. Invertebrate Paleontology
- 243-244. Micropaleontology  
247. Paleoecology  
\*300. Seminar in Oceanography  
305. Seminar in Continental Drift and Global Tectonics  
\*310. Seminar in Stratigraphy  
\*312. Seminar in Sedimentology  
\*320. Seminar in Mineralogy  
\*330. Seminar in Geochemistry  
\*340. Seminar in Paleontology  
\*350. Seminar in Geomathematics  
\*371, 372. Advanced Topics in Geology

Germanic Languages and Literature

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

\*Offered on demand.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second year) of college German with acceptable grades.

#### Professor

Leland R. Phelps, Ph.D. (Ohio State), *Chairman and Director of Graduate Studies*.

#### Associate Professors

Frank Borchardt, Ph.D. (Johns Hopkins); James L. Rolleston, Ph.D. (Yale).

#### Assistant Professor

A. Tilo Alt, Ph.D. (Texas).

#### Courses of Instruction

- |   |   |
|---|---|
| 201S, 202S. Goethe                          | 217S. Renaissance and Reformation Literature      |
| 203S, 204S. Eighteenth Century              | 218S. The Teaching of German                      |
| 205, 206. Middle High German                | 219. Applied Linguistics                          |
| 207S, 208S. German Romanticism              | 232. Criticism                                    |
| 209S, 210S. Kleist, Grillparzer, and Hebbel | 233. Advanced Composition                         |
| 211S, 212S. Nineteenth Century Literature   | *301. Gothic                                      |
| 213S. Heinrich Heine                        | *316. The Austrian Novel from 1930 to the Present |
| 214S. The Twentieth Century                 | 321, 322. Germanic Seminar                        |
| 215S. Seventeenth Century Literature        | — Graduate Reading Course                         |
| 216. History of the German Language         |   |

## Health Administration

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-month academic program that leads to the M.H.A. degree. Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study.

#### Professors

Montague Brown, Ph.D. (North Carolina at Chapel Hill); David G. Warren, J.D. (Duke).

#### Associate Professors

Boi Jon Jaeger, Ph.D. (Duke), *Chairman*; Barbara McCool, Ph.D. (Ohio State); Wilma A. Minniear, M.S. (Case Western Reserve); Louis E. Swanson, A.B. (Hamilton).

#### Assistant Professors

Mary M. Blanks, M.H.A. (Duke); Thomas J. Delaney, M.S. (U.S. Naval Postgraduate School); David J. Falcone, Ph.D. (Duke); Donald S. Smith II, M.H.A. (Minnesota), *Director of Graduate Studies*.

#### Adjunct Associate Professors

Elizabeth J. Coulter, Ph.D. (Radcliffe); Florence Kavalier, M.P.H. (Columbia), M.D. (State Univ. of New York); Richard H. Peck, M.H.A. (Duke).

#### Adjunct Assistant Professor

Arnold D. Kaluzny, Ph.D. (Michigan).

#### Lecturers

Jeff H. Steinert; Robert G. Winfree, M.A. (Iowa).

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\*Offered on demand.

Courses of Instruction

301. The Health System and Its Environment  
312. Comparative Health Systems  
314. Social Dimensions of Health Services  
321. Operations Research for Health Administration  
322. Public Policy and Health Care  
324. Institutional Health Services  
326. Health Economics  
331, 332. Planning Health Services  
335. Ambulatory Health Services
- 341, 342. Case Studies in Health Administration  
344. Health Manpower  
346. Community Health Services  
348. Legal and Regulatory Constraints on Health Services  
350. The Administrative Residency (Basic)  
360. Seminar in Health Administration  
371, 372. Directed Research  
380. Administrative Residency (Advanced)

History

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to his program of study and have completed successfully a substantial research paper, normally the product of a year's seminar or two semester-courses. The paper must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, modern Russia, Latin America, South Asia, modern China, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

Professors

John R. Alden, Ph.D. (Michigan), *James B. Duke Professor of History*; Joel G. Colton, Ph.D. (Columbia); Robert F. Durden, Ph.D. (Princeton), *Chairman*; Arthur B. Ferguson, Ph.D. (Cornell); Irving B. Holley, Jr., Ph.D. (Yale); Frederic Hollyday, Ph.D. (Duke); Warren Lerner, Ph.D. (Columbia); John F. Oates, Ph.D. (Yale); Harold T. Parker, Ph.D. (Chicago); Richard A. Preston, Ph.D. (Yale), *William K. Boyd Professor of History*; Theodore Ropp, Ph.D. (Harvard); Anne Firor Scott, Ph.D. (Radcliffe), *Director of Graduate Studies*; William E. Scott, Ph.D. (Yale); John J. TePaske, Ph.D. (Duke); Richard W. Watson, Ph.D. (Yale); Charles Young, Ph.D. (Cornell).

Associate Professors

John Cell, Ph.D. (Duke); William Chafe, Ph.D. (Columbia); Calvin D. Davis, Ph.D. (Indiana); Gerald Hartwig, Ph.D. (Indiana); Seymour Mauskopf, Ph.D. (Princeton); Martin Miller, Ph.D. (Chicago); Sydney Nathans, Ph.D. (Johns Hopkins); Ronald Witt, Ph.D. (Harvard); Peter H. Wood, Ph.D. (Harvard).

Assistant Professors

Charles W. Bergquist, Ph.D. (Stanford); Philip B. Calkins, Ph.D. (Chicago); Arif Dirlik, Ph.D. (Rochester); Raymond Gavins, Ph.D. (Virginia); Lawrence C. Goodwyn, Ph.D. (Texas); Alan Stone, Ph.D. (Washington Univ.).

Courses of Instruction

- 201S, 202S. Aspects of Change in Prerevolutionary Russia.
203. The Uses of History in Public Policy Making; I

204. The Uses of History in Public Policy: II
- 207, 208. The Development of Urban America
- 209, 210. Selected Topics in Afro-American History, 1619-Present
212. Recent Interpretations of United States History
- 215-216. The Diplomatic History of the United States
- 217, 218. Recent European History
221. Problems in the Economic and Social History of Europe, 1200-1700
222. Problems in European Intellectual History, 1250-1550
- 223S, 224S. The Old Regime, the Enlightenment, and the French Revolution
- 227-228. Recent United States History: Major Political and Social Movements
229. Recent Interpretations of Modern European History
- 231S, 232S. Problems in the History of Spain and the Spanish Empire
- 237S. Europe in the Early Middle Ages
- 238S. Europe in the High Middle Ages
240. Aspects of Traditional and Modern African Culture
- 241-242. Modernization and Revolution in China
247. History of Modern India and Pakistan, 1707-1857
248. History of Modern India and Pakistan, 1857 to the Present
- 249-250. Social and Intellectual History of the United States
- 253-254. Modern European Intellectual History
- 255S-256S. Problems in African History
- 257S, 258S. Modern East Asia: Introduction to Problems and Literature
260. Economic History of Japan
- 261-262. Problems in Soviet History
- 263-264. American Colonial History and the Revolution, 1607-1789
- 265S, 266S. Problems in Modern Latin American History
- 267S-268S. From Medieval to Early Modern England
- 269-270. British History, Seventeenth Century to the Present
- 273-274. Topics in the History of Science
- 275S, 276S. Central Europe, 1848-1918
- 277S. The Coming of the Civil War in the United States, 1820-1861
- 278S. The Civil War in the United States and its Aftermath, 1861-1900
- 279S. Oral History
280. Historiography
- 283-284. Political and Social Change in the United States, 1789-1800
- 287-288. History of Modern Japan
- 297S. The British Empire of the Nineteenth Century
- 298S. The Commonwealth in the Twentieth Century
- 307-308. Seminar in United States History
- 317-318. Seminar in the History of Western Europe
- 371-372. Research Seminars
401. Seminar on the British Commonwealth
- 351.1-352.1. Military History
- 351.2-352.2. Modern European Intellectual and Cultural History
- 351.10-352.10. Medieval Europe
- 351.15-352.15. The English Renaissance
- 351.25-352.25. Central Europe, 1849-1914
- 351.30-352.30. European Diplomatic History Since 1870
- 351.31-352.31. Twentieth Century Europe
- 351.40-352.40. City and Frontier in United States History
- 351.45-352.45. Reform and Politics in Nineteenth Century America
- 351.46-352.46. Twentieth Century United States to 1941
- 351.47-352.47. Diplomatic History of the United States
- 351.51-352.51. Hispanic America
- 351.60-352.60. Soviet History
- 351.65-352.65. Modernization and Revolution in China
- 351.70-352.70. Modern South Asia
- 351.74-352.74. American Colonial History and the Revolution
312. Seminar in the Teaching of History in College
314. Historical and Social Science Methodology
399. Independent Study

## Marine Sciences—The University Program

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are botany, chemistry, geology, and zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.



Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University *Marine Laboratory Bulletin*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Duke University *Marine Laboratory Bulletin* for the current schedule of courses.

#### Professors

Cazlyn Green Bookhout, Ph.D. (Duke); John Costlow, Ph.D. (Duke); *Director*; Terry W. Johnson, Jr., Ph.D. (Michigan); \*Orrin Pilkey, Ph.D. (Florida State).

#### Associate Professors

Richard T. Barber, Ph.D. (Stanford); \*Richard B. Searles, Ph.D. (California at Berkeley).

#### Assistant Professors

Rodger W. Baier, Ph.D. (Washington); William F. Blankley, Ph.D. (California at San Diego); Richard B. Forward, Ph.D. (California at Santa Barbara); John Gutknecht, Ph.D. (North Carolina at Chapel Hill); J. Bolling Sullivan, Ph.D. (Texas); John Sutherland, Ph.D. (California at Berkeley).

\*In residence at the Marine Laboratory during the summer only.

#### Courses of Instruction

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|--|--|
| 202. Phytoplankton Systematics               | 240. Chemical Oceanography                     |
| 203. Marine Ecology                          | 250. Physiological Ecology of Marine Animals   |
| 204. Marine Microbiology                     | 252. Marine Electrobiolgy                      |
| 205. Geological Oceanography                 | 274. Marine Invertebrate Zoology               |
| 211. Marine Phycology                        | 276. Comparative and Evolutionary Biochemistry |
| 212. Membrane Physiology and Osmoregulations | 278. Invertebrate Embryology                   |
| 214. Biological Oceanography                 | 353, 354. Research                             |
| 230. Environmental Oceanography              |  |

## Mathematics

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis involving the use of the computer.

All A.M. and Ph.D. degree candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will usually take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. degree candidates are expected to participate in a proseminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. degree candidate should satisfy the language requirement in two of these languages as early as possible. The department offers departmentally administered language examinations as an alternative to the ETS examinations.

## Professors

William K. Allard, Ph.D. (Brown); Leonard Carlitz, Ph.D. (Pennsylvania), *James B. Duke Professor of Mathematics*; Francis Joseph Murray, Ph.D. (Columbia); Michael C. Reed, Ph.D. (Stanford); Joseph Robert Shoenfield, Ph.D. (Michigan); Seth L. Warner, Ph.D. (Harvard), *Chairman*; Morris Weisfeld, Ph.D. (Yale), *Director of Graduate Studies*.

## Associate Professors

Donald Stanley Burdick, Ph.D. (Princeton); Richard Earl Hodel, Ph.D. (Duke); Joseph W. Kitchen, Jr., Ph.D. (Harvard); David P. Kraines, Ph.D. (California at Berkeley); Lawrence Carlton Moore, Jr., Ph.D. (California Inst. of Tech.); Richard A. Scoville, Ph.D. (Yale); David A. Smith, Ph.D. (Yale); Olaf Patrick Stackelberg, Ph.D. (Minnesota).

## Assistant Professors

Edmund Butler, Ph.D. (New York Univ.); Murray Cantor, Ph.D. (California at Berkeley); Jack A. Lees, Ph.D. (Chicago); Barry MacKichan, Ph.D. (Stanford).

## Visiting Associate Professor

Allan Gut, Ph.D. (Uppsala Univ.).

## Adjunct Associate Professor

Jagdish Chandra, Ph.D. (Rensselaer).

## Courses of Instruction

- |   |   |
|---|---|
| 204. Geometry for Teachers                          | *287, 288. Foundations of Mathematics                   |
| 206. Introduction to Stochastic Processes           | 290. Stochastic Processes                               |
| 207, 208. Introduction to Algebraic Structures      | 291, 292. Analysis I, II                                |
| 217, 218. Intermediate Analysis                     | 293. Multivariate Statistics                            |
| 221, 222, 223. Numerical Analysis                   | *295. Mathematical Foundations of Statistical Inference |
| *227, 228. Theory of Numbers                        | 297, 298. Axiomatic Set Theory                          |
| *229, 230. Algebraic Numbers                        | *303, 304. Advanced Theory of Numbers                   |
| 231. Applications of Graph Theory                   | 325, 326. Analysis III, IV                              |
| *234. Sample Designs                                | *327, 328. Partial Differential Equations               |
| 235, 236. Algebra                                   | *329, 330. Theory of Distributions                      |
| 244. Analysis of Variance                           | *331, 332. Advanced Topics in Complex Variables         |
| *245, 246. Combinatorial Analysis                   | *333, 334. Analytic Theory of Numbers                   |
| *247, 248. Arithmetic of Polynomials                | *335, 336. Topics in Algebra                            |
| 256. Orientation for Applied Mathematics            | *343, 344. Differential Equations                       |
| 260. Design of Experiments                          | *353, 354. Topics in Analysis                           |
| *262. Non-Parametric Statistics                     | 361, 362. Hilbert Space                                 |
| 265, 266. Homological Algebra and its Applications  | *371, 372. Dimension Theory                             |
| 268. Mathematical Foundations of General Relativity | 375. Advanced Point Set Topology                        |
| 269, 270. Recursive Function Theory                 | *377, 378. Topics in Topology                           |
| 271. Point Set Topology                             | *383, 384. Lie Groups and Algebras                      |
| 272. Introductory Algebraic Topology                | *392. Nuclear Spaces                                    |
| 273. Algebraic Topology                             | *393. Topological Groups                                |
| 274. Geometric Topology                             | *394. Topological Rings                                 |
| 275, 276. Probability                               | *395, 396. Topological Algebra                          |
| 284. Least Squares Analysis of Linear Models        | *397, 398. Seminar in Algebra and Number Theory         |
| 285. Applied Mathematical Methods I                 |   |
| 286. Applied Mathematical Methods II                |   |

## Program in Medieval and Renaissance Studies

A graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A participating student is based in one of the regular departments and fulfills the Ph.D. requirements for that discipline, and in addition he takes a program of electives which will aid his interdisciplinary competence in the medieval or Renaissance area (or some intellectually valid combination of the two). Such a program includes a choice from the fields of art, history, language and literature, history, philosophy, and religion. In other words, a student is enabled to minor in medieval and Renaissance studies.

\*Offered on demand.

Inquiries should be addressed to the Chairman of the Duke University Committee on Medieval and Renaissance Studies, P. O. Box 466, Duke Station.

### ART

234. Romanesque Sculpture

237. French Renaissance Art

### LATIN

221. Medieval Latin I

306. Latin Seminar VI

222. Medieval Latin II

312. Proseminar in Latin Paleography

225. Paleography

327. Seminar in Byzantine History

305. Latin Seminar V

### ENGLISH

207. Old English Grammar and Readings

232. Milton

208. History of the English Language

310. Beowulf

210. Old English Literary Tradition

312. Studies in Middle English Literature

212. Middle English Literary Tradition

315. Studies in Chaucer

215, 216. Chaucer

318. Medieval Romances

221. English Prose of the Sixteenth Century

320. Studies in Renaissance English Prose

222. English Non-Dramatic Poetry of the Sixteenth Century

324. Studies in Shakespeare

223. Spenser

325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries

224. Shakespeare

329. Studies in the Metaphysical Poets

225, 226. Tudor and Stuart Drama, 1500-1642

383. Textual Criticism

229. English Literature of the Seventeenth Century

### GERMAN

205, 206. Middle High German

216. History of the German Language

215. Seventeenth Century Literature

217. Renaissance and Reformation Literature

### HISTORY

221. Problems in the Economic and Social History of Europe, 1200-1700

238. Europe in the High Middle Ages

222. Problems in European Intellectual History, 1250-1550

267-268. From Medieval to Early Modern England

237. Europe in the Early Middle Ages

351.10-352.10. Medieval Europe

351.15-352.15. The English Renaissance

### PHILOSOPHY

218. Medieval Philosophy

### RELIGION

219. Augustine

336. Christian Mysticism in the Middle Ages

236. Luther and the Reformation in Germany

338. Calvin and the Reformation in Switzerland

241. Problems in Reformation Theology

339. The Radical Reformation

251. The Counter-Reformation and the Development of Catholic Dogma

344. Zwingli and the Origins of Reformed Theology

334. Theology and Reform in the Later Middle Ages

### FRENCH

213, 214. French Literature of the Seventeenth Century

225. French Prose of the Sixteenth Century

219. Old French Literature

226. French Poetry of the Sixteenth Century

224. History of the French Language

311, 312. French Seminar (Medieval and Renaissance Topics)

### ITALIAN

284. Dante

288. The Renaissance

285. Dante

### SPANISH

251. The Origins of Spanish Prose Fiction

253. The Origin of the Spanish Theater

252. Spanish Lyric Poetry before 1700

257. Old Spanish Language

## Microbiology and Immunology

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

### Professors

D. Bernard Amos, M.D. (Guys Hospital, London), *James B. Duke Professor of Immunology*; Richard O. Burns, Ph.D. (Illinois); Eugene D. Day, Ph.D. (Delaware); Wolfgang Karl Joklik, D.Phil. (Oxford), *James B. Duke Professor of Microbiology and Immunology and Chairman*; Richard S. Metzgar, Ph.D. (Buffalo); Suydam Osterhout, M.D. (Duke), Ph.D. (Rockefeller Inst.); Robert W. Wheat, Ph.D. (Washington); Hilda Pope Willett, Ph.D. (Duke), *Director of Graduate Studies*.

### Associate Professors

C. Edward Buckley III, M.D. (Duke); Rebecca Buckley, M.D. (North Carolina at Chapel Hill); Jack L. Nichols, Ph.D. (Alberta); Wendell Rosse, M.D. (Chicago); H. F. Seigler, M.D. (North Carolina at Chapel Hill); Ralph E. Smith, Ph.D. (Denver); Thomas C. Vanaman, Ph.D. (Duke); Frances E. Ward, Ph.D. (Brown); Hans Zweerink, Ph.D. (Cornell).

### Assistant Professors

Dani P. Bolognesi, Ph.D. (Duke); Peter Cresswell, Ph.D. (London Univ.); Jeffrey B. Dawson, Ph.D. (Case Western Reserve); David J. Lang, M.D. (Harvard); Peter K. Lauf, Ph.D. (Freiburg); Nelson Levy, M.D. (Columbia), Ph.D. (Duke); Thomas G. Mitchell, Ph.D. (Tulane); David W. Scott, Ph.D. (Yale); Ralph Snyderman, M.D. (New York Downstate Medical Center).

### Courses of Instruction

- |  |  |
|--|--|
| 212, 213. Research Techniques in Microbiology and Immunology | 291. Basic Immunology                        |
| 219. Molecular and Cellular Basis of Development             | 296. Immunochemistry                         |
| 219S. Seminar  | 323. Readings in Bacteriology and Immunology |
| 221. Medical Microbiology                                    | 325. Medical Mycology                        |
| 233. Microbiology  | 330. Medical Immunology                      |
| 242. Mechanisms of Microbial Pathogenicity                   | 331.1-331.8. Microbiology Seminar            |
| 252. General Virology and Viral Oncology                     | 332.1-332.8. Immunology Seminar              |
| 282. Molecular Microbiology                                  | 336. Immunogenetics                          |
|  | 420. Cellular Immunophysiology               |

## Pathology

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of specialty and research. Further information including brochures giving details of departmental facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

### Professors

Bernard F. Fetter, M.D. (Duke); Donald B. Hackel, M.D. (Harvard); Robert E. Jennings, M.D. (Northwestern), *Chairman*; William W. Johnston, M.D. (Duke); Thomas D. Kinney, M.D. (Duke), *R. J. Reynolds Tobacco Company Professor of Medical Education*; Gordon K. Klintworth, M.D., Ph.D. (Witwatersrand); Joachim R. Sommer, M.D. (Munich), *Director of Graduate Studies*; Philip Pratt, M.D. (Johns Hopkins); F. Stephen Vogel, M.D. (Western Reserve); Benjamin Wittels, M.D. (Minnesota).



**Associate Professors**

William D. Bradford, M.D. (Western Reserve); Jane G. Elchlepp, Ph.D. (Iowa), M.D. (Chicago); Norman B. Ratliff, M.D. (Duke).

**Assistant Professors**

Dolph O. Adams, M.D., Ph.D. (North Carolina at Chapel Hill); Peter Anderson, Ph.D. (Oregon); Darell D. Bigner, M.D., Ph.D. (Duke); Edward H. Bossen, M.D. (Duke); Charles Daniels, M.D., Ph.D. (Duke); Doyle G. Graham, M.D., Ph.D. (Duke); Hal Hawkins, M.D., Ph.D. (Duke); Hugo Jauregui, M.D., Ph.D. (Duke); John D. Shelburne, M.D., Ph.D. (Duke); Craig Tisher, M.D. (Washington Univ.); James W. Wilson, Ph.D. (Kentucky), M.D. (Duke); Peter Zwadyk, Ph.D. (Iowa).

**Courses of Instruction**

219. Molecular and Cellular Basis of Development  
219S. Seminar  
250. General Pathology  
251. Laboratory Course in General Pathology  
258. Cellular and Subcellular Pathology  
275. Fundamentals of Electron Microscopy  
325. Cardiovascular Pathology  
352. Basic Problems in Chemical Pathology  
353. Advanced Neuropathology  
355, 356. Graduate Seminar in Pathology  
357. Research in Pathology
360. Histochemistry  
361, 362. Autopsy Pathology  
364. Systemic Pathology  
367, 368. Special Topics in Pathology  
369. Ophthalmic Pathology  
370. Developmental Pathology and Teratology  
373. Cytopathology  
374. Pulmonary Pathology and Postmortem Pathophysiology  
377. Pathology of the Kidney  
378. Immunopathology  
379. Pathology of Virus Infections

**Philosophy**

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophy of mind, philosophical analysis, ethics, aesthetics, political philosophy, philosophy of law, and philosophy of religion.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take one or two qualifying examinations which are diagnostic in purpose. One examination tests his ability to deal critically and systematically with some basic philosophical topic; a second examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

**Professors**

William Bernard Peach, Ph.D. (Harvard), *Acting Chairman*; Paul Welsh, Ph.D. (Cornell).

**Associate Professors**

Edward P. Mahoney, Ph.D. (Columbia); George W. Roberts, Ph.D. (Cambridge), *Director of Graduate Studies*; David H. Sanford, Ph.D. (Cornell).

**Assistant Professor**

David J. Ross, Ph.D. (Stanford).

### Courses of Instruction

- |   |   |
|---|---|
| 202. Aesthetics: The Philosophy of Art  | 233. Methodology of the Empirical Sciences        |
| 203. Contemporary Ethical Theories      | 234. Problems in the Philosophy of Science        |
| 204. Philosophy of Law                  | 241. Symbolic Logic                               |
| 205. Philosophy of History              | 251. Epistemology                                 |
| 206. Topics in Ethical Theory           | 252. Metaphysics                                  |
| 208. Political Values                   | 253. Philosophy of Mind                           |
| 211. Plato                              | 254. Philosophy of Religion                       |
| 217. Aristotle                          | 255. Philosophy of Action                         |
| 218. Medieval Philosophy                | 260. Wittgenstein                                 |
| 225. British Empiricism                 | 287, 288. Foundations of Mathematics              |
| 227. Continental Rationalism            | 291, 292. Seminar in Special Fields of Philosophy |
| 228. Recent and Contemporary Philosophy | 331, 332. Seminar in Special Fields of Philosophy |
| 230. The Meaning of Religious Language  |   |
| 231. Kant's Critique of Pure Reason     |   |
| 232. Recent Continental Philosophy      |   |

## Physical Therapy

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and statistics. In the first year of the curriculum students are required to take courses in anatomy and physiology, offered by those respective departments. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3965, Duke University Medical Center.

### Associate Professors

Eleanor F. Branch, Ph.D. (Duke), *Acting Co-Chairman and Director of Graduate Studies*; Elia E. Vallanueva, A.M. (Duke).

### Courses of Instruction

- |   |   |
|---|---|
| 201, 202. Seminar in Physical Therapy                   | 243, 244. Directed Clinical Experience in Physical Therapy II |
| 217. Physical Therapy Dynamics I                        | 297-298. Special Topics in Physical Therapy                   |
| 218. Physical Therapy Dynamics II                       | 301. Introduction to Scientific Inquiry                       |
| 220. Physical Therapy Dynamics III                      | 315. Curriculum Development                                   |
| 230, 231. Physical Evaluation and Instrumentation       | 316. Directed Teaching in Physical Therapy                    |
| 234. Introductory Pathology                             | 320. Sensorimotor Mechanisms Related to Rehabilitation        |
| 236. Medical Sciences                                   | 322. Case Conferences in Rehabilitation                       |
| 238. Introduction to Health Service Systems             | 332. Administration of Physical Therapy Services              |
| 240. Prosthetics and Orthotics                          | 350. Research   |
| 242. Directed Clinical Experience in Physical Therapy I |   |

## Physics

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

## Professors

L. C. Biedenharn, Jr., Ph.D. (Massachusetts Inst. of Tech.); Edward G. Bilpuch, Ph.D. (North Carolina at Chapel Hill); Henry A. Fairbank, Ph.D. (Yale); Walter Gordy, Ph.D. (North Carolina at Chapel Hill), LL.D., D.H.C., *James B. Duke Professor of Physics*; Harold W. Lewis, Ph.D. (Duke); Horst Meyer, D.Sc. (Geneva); Henry W. Newson, Ph.D. (Chicago), *James B. Duke Professor of Physics*; Russell Roberson, Ph.D. (Johns Hopkins); Hugh G. Robinson, Ph.D. (Duke); William D. Walker, Ph.D. (Cornell), *Chairman*; Richard L. Walter, Ph.D.

## Associate Professors

Ron Y. Cusson, Ph.D. (California Inst. of Tech.); Lawrence E. Evans, Ph.D. (Johns Hopkins), *Director of Graduate Studies*; Lloyd R. Fortney, Ph.D. (Wisconsin); Moo-Young Han, Ph.D. (Rochester).

## Assistant Professors

Frank C. DeLucia, Ph.D. (Duke); Zvi Friedman, Ph.D. (Tel Aviv Univ.); Alfred T. Goshaw, Ph.D. (Wisconsin); Dewey T. Lawson, Ph.D. (Duke); Paul W. Lisowski, Ph.D. (Duke); James S. Loos, Ph.D. (Illinois); Robert Kent Smith, Ph.D. (Maryland).

## Adjunct Professors

Fearghus O'Foghludha, Ph.D. (National Univ. of Ireland); Herman Robl, Ph.D. (Vienna); Katherine Way, Ph.D. (North Carolina at Chapel Hill).

## Courses of Instruction

- |   |   |
|---|---|
| 211, 212. Advanced Modern Physics                   | 312. Phase Transitions and Critical Phenomena     |
| 215. Introduction to Quantum Mechanics              | 316. Principles of Quantum Theory                 |
| 217S, 218S. Advanced Physics Laboratory and Seminar | 317. Intermediate                                 |
| 220. Electronics                                    | 318. Electromagnetic Field Theory                 |
| 223. Electricity and Magnetism                      | *330. Nuclear Structure Theory                    |
| 268. Mathematical Foundations of General Relativity | *Offered on demand.                               |
| 280. Nuclear Reactor Physics                        | *331. Microwave Radiation                         |
| 282. Mechanics of Continuous Media                  | *335. Microwave Spectroscopy                      |
| 302. Advanced Mechanics                             | *341. Advanced Topics in Quantum Theory           |
| 303. Statistical Mechanics                          | *342. Theory of Elementary Particles              |
| *304. Advanced Topics in Statistical Mechanics      | *343. Nuclear Physics                             |
| 305. Introduction to Nuclear Physics                | *344. Advanced Nuclear Physics                    |
| *306. Low Temperature Physics                       | *345. High Energy Physics                         |
| 308. Introduction to High Energy Physics            | *346. Topics in Theoretical Physics               |
| 309. Solid State Physics I                          | 351, 352. Seminar                                 |
| *310. Solid State Physics II                        | 397, 398. Low Temperature and Solid State Seminar |

## Physiology and Pharmacology

The Department of Physiology and Pharmacology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, or engineering. There is no foreign language requirement. All graduate students are required to take the introductory courses in both physiology and pharmacology. A brochure which describes the program of study, facilities, and research activities of the staff is available from the Director of Graduate Studies.

## Professors

F. Bernheim, Ph.D. (Cambridge); *James B. Duke Professor of Pharmacology*; J. J. Blum, Ph.D. (Chicago); George H. Hitchings, Ph.D. (Harvard); F. Jobsis, Ph.D. (Michigan); E. A. Johnson, M.D. (Sheffield, England); L. Lack, Ph.D. (Columbia); Robert Arthur Maxwell, Ph.D. (Princeton); J. W. Moore, Ph.D. (Virginia); T. Narahashi, Ph.D. (Tokyo); Charles Adams Nichol, Ph.D. (Wisconsin); Athos Ottolenghi, M.D. (Pavia), *Director of Graduate Studies*; S. Schanberg, Ph.D., M.D. (Yale); G. Somjen, M.D. (New Zealand).

\*Offered on demand.

## Associate Professors

N. C. Anderson, Ph.D. (Purdue); R. E. Fellows, Jr., M.D. (McGill), Ph.D. (Duke); J. Gutknecht, Ph.D. (North Carolina); Johannes A. Kylstra, M.D., Ph.D. (Leiden); P. K. Lauf, M.D. (Freiburg); Melvyn Lieberman, Ph.D. (New York Downstate Medical Center); T. J. McManus, M.D. (Boston); L. M. Mendell, Ph.D. (Massachusetts Inst. of Tech.); Daniel B. Menzel, Ph.D. (California at Berkeley); E. Mills, Ph.D. (Columbia); G. M. Padilla, Ph.D. (California at Los Angeles); Herbert S. Posner, Ph.D. (George Washington Univ.); J. V. Salzano, Ph.D. (Iowa); *Acting Chairman*; Theodore A. Slotkin, Ph.D. (Rochester); Madison S. Spach, M.D. (Duke); M. Wolbarsht, Ph.D. (Johns Hopkins).

## Assistant Professors

Reginald D. Carter, Ph.D. (Bowman Gray); Walter N. Duran, Ph.D. (Duke); Joseph Ellinwood, Jr., M.D. (North Carolina at Chapel Hill); Joseph C. Greenfield, M.D. (Emory); James E. Hall, Ph.D. (California at Riverside); J. Mailen Kootsey, Ph.D. (Brown); Harold E. Lebovitz, M.D. (Pittsburgh); Lazaro J. Mandel, Ph.D. (Pennsylvania); Donald H. Namm, Ph.D. (Albany Medical College); Fidel Ramon, Ph.D. (Duke); Gerald M. Rosen, Ph.D. (Clarkson); Myron Rosenthal, Ph.D. (Duke); C. W. Schomberg, Ph.D. (Purdue); James M. Schooler, Ph.D. (Wisconsin); H. C. Wachtel, Ph.D. (New York Univ.); Andrew G. Wallace, M.D. (Duke).

## Courses of Instruction

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|--|---|
| 204. Introduction to Modern Physiology                       | 321. Gastrointestinal and Renal Physiology                            |
| 208. Respiratory System in Health and Diseases               | 330. Pharmacological Basis of Clinical Medicine                       |
| 210, 211. Individual Study and Research                      | 331. Laboratory Methods in Pharmacology                               |
| 212. Membrane Physiology and Osmoregulation                  | 334. Pharmacodynamics   |
| 215. Topics in Developmental Physiology                      | 335. Drug Receptor Theory   |
| 216. Contractile Processes                                   | 362. Current Topics in Cardiac Muscle Physiology                      |
| 217. Membrane Transport                                      | 372. Research in Physiology and Pharmacology                          |
| 220. Physiology of Exercise                                  | 383. Physiological Instrumentation                                    |
| 222. Marine Electrobiological                                | 386. Laboratory Methods in Electrophysiology                          |
| 225. An Introduction to Neuronal Physiology and Pharmacology | 393. Integrative and Clinical Neurophysiology                         |
| 230. Molecular and Cellular Basis of Development             | 401. Metabolic and Developmental Physiology                           |
| 230S. Optional Seminar                                       | 414. Analysis of Physiological Systems                                |
| 250. Pharmacology: Mode of Action of Drugs                   | 416. Biophysics of Excitable Membranes                                |
| 252. Cellular and Chemical Pharmacology                      | 417. Cellular Endocrinology   |
| 254. Mammalian Toxicology                                    | 418. Reproductive Biology   |
| 256. Human Nutrition   | 419. Topics in Mathematical Physiology                                |
| 280. Student Seminar in Physiology and Pharmacology          | 420. Cellular Immunophysiology  |
| 281. Teaching Methods in Physiology                          | 422. Advanced Seminar in Endocrinology and Reproductive Physiology I  |
| 282. Teaching Methods in Pharmacology                        | 423. Advanced Seminar in Endocrinology and Reproductive Physiology II |
| 311. Physiological Basis of Medicine                         |   |

## Political Science

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government. Fields in which instruction is offered currently are American government and politics, comparative government and politics, political theory, international relations, and empirical theory and methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least twelve courses in the department and demonstrate competence in at least three general fields of the discipline as well as in a fourth general field or in a special sub-field or in a field external to the department. He must also demonstrate a reading knowledge of two foreign languages or he must demonstrate proficiency in one foreign language and in the use of statistics.



Further details about the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.

### Professors

James David Barber, Ph.D. (Yale), *Chairman*; Ralph Braibanti, Ph.D. (Syracuse), *James B. Duke Professor of Political Science*; Frederic N. Cleaveland, Ph.D. (Princeton); Kazimierz Grzybowski, S.J.D. (Harvard); Hugh Marshall Hall, Jr., Ph.D. (Texas); John Hamilton Hallowell, Ph.D. (Princeton); Ole R. Holsti, Ph.D. (Stanford); Jerry F. Hough, Ph.D. (Harvard); Allan Kornberg, Ph.D. (Michigan); Richard H. Leach, Ph.D. (Princeton).

### Associate Professors

Peter Fish, Ph.D. (Johns Hopkins); Willis F. Hawley, Ph.D. (California at Berkeley), *Sheridan Johns III, Ph.D. (Harvard), Director of Graduate Studies*; David Paletz, Ph.D. (California at Los Angeles); David E. Price, B.D., Ph.D. (Yale); Ronald L. Rogowski, Ph.D. (Princeton); Thomas A. Spragens, Ph.D. (Duke).

### Assistant Professors

Albert Eldridge, Ph.D. (Kentucky); Margaret A. McKean, Ph.D. (California at Berkeley); William Mishler, Ph.D. (Duke); Lester M. Salamon, Ph.D. (Harvard); Richard Trilling, Ph.D. (Wisconsin); Arturo Valenzuela, Ph.D. (Columbia).

### Lecturers

Jean F. O'Barr, Ph.D. (Northwestern); Deborah A. Stone, B.A. (Michigan).

### Courses of Instruction

- |   |   |
|---|---|
| 204. Ethics in Political Life                                 | 244. Administrative Law and Process                                   |
| 206. Politics and the Media                                   | 245S. Ethics and Policymaking   |
| 207. American Constitutional Interpretation                   | 246. Administration and Public Policy                                 |
| 209. Problems in State Government and Politics                | 247. Political Participation and Policy Outcomes                      |
| 210. The Politics of Education                                | 248. The Politics of the Policy Process                               |
| 211. Contemporary Japanese Politics                           | 249. Comparative Political Analysis and Political Development         |
| 212. Japanese Foreign Policy                                  | 250. Comparative Government and Politics: Southern Asia               |
| 214. Comparative Administrative Law                           | 252. Comparative Political Behavior and Socialization                 |
| 215. Comparative Legislative Processes                        | 253. Comparative Government and the Study of Latin America            |
| 216S. Comparative Politics of the Welfare State               | 257S, 258S. Modern East Asia. Introduction to Problems and Literature |
| 217S. Economic Theories of Political Behavior                 | 260. The Tradition of Political Inquiry                               |
| 218S-219S. Political Thought in the United States             | 271. Political Processes in Traditional and Modern Africa             |
| 220S. Problems in International Politics                      | 273S. The American South as a "Developing Society"                    |
| 221. International Organization                               | 274. Political Psychology   |
| 222. Empirical Theory   | 275. The American Party System  |
| 223. Political Philosophy from Plato to Machiavelli           | 277. Comparative Party Politics                                       |
| 224. Modern Political Theory                                  | 278. Canadian Political Behavior in the North American Context        |
| 225. Comparative Government and Politics: Western Europe      | 279. The Legislative Process  |
| 226. Theories of International Relations                      | 280. Comparative Government and Politics: Sub-Saharan Africa          |
| 227. International Law  | 283S. Congressional Policymaking                                      |
| 228. Soviet Public International Law                          | 285. The Judicial Process   |
| 229. Recent and Contemporary Political Theory                 | 291. Problems of Urban Government                                     |
| 230. American National Government                             | 293. Federalism   |
| 231. American Political Theory                                | 301. Teaching Political Science                                       |
| 233. Research Methodology                                     | 303. Seminar on Selected Topics in Statistics                         |
| 235. The Commonwealth   | 306. Seminar in Politics and the Mass Media of Communication          |
| 236. Statistical Analysis                                     | 307. Graduate Seminar in American Voting Behavior                     |
| 237S. Problems in American Foreign Policy                     |   |
| 238. Comparative Foreign Policy                               |   |
| 239S. Current Problems of International Law                   |   |
| 241. Public Administrative Organization and Management        |   |
| 243. Applications of Administrative and Organizational Theory |   |

308. Individual Research in Political Science
309. Seminar in International Relations
310. Seminar in State and Local Government
312. Seminar in Constitutional Law
313. Education and Public Policy
321. Seminar in Political Theory
322. Seminar in Selected Topics in Empirical and Formal Theory
323. Seminar in Modern Political Theory
325. Seminar in Comparative Government and Politics
329. Seminar in International Regional Organization
330. Seminar in Comparative Government and Politics—Southern Asia
331. Seminar in American Political Thought
340. Seminar in American Politics and Institutions
341. Seminar in Public Administration
342. Seminar in American National Government and Politics
343. Seminar in the Policy Process
344. Workshop on Computer Models of Social Systems
360. Seminar in Government and Politics in the Soviet Union
361. Seminar in Foreign Relations of the Soviet Union
376. Seminar in Comparative Political Behavior
380. Seminar in African Government and Politics
381. Research Seminar in Latin American Government and Politics
382. Soviet Law and Society
401. Seminar in the Commonwealth
402. Interdisciplinary Seminar in the History of the Social Sciences

## Psychology

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

### Professors

Irving Emanuel Alexander, Ph.D. (Princeton), *Chairman*; William Bevan, Ph.D. (Duke), *William Preston Few Professor of Psychology*; Lloyd Joseph Borstelmann, Ph.D. (California at Berkeley); Robert Charles Carson, Ph.D. (Northwestern); Irving Thomas Diamond, Ph.D. (Chicago), *James B. Duke Professor of Psychology*; Robert Porter Erickson, Ph.D. (Brown); Norman Guttman, Ph.D. (Indiana); Edward Ellsworth Jones, Ph.D. (Harvard); Martin Lakin, Ph.D. (Chicago); Gregory Roger Lockhead, Ph.D. (Johns Hopkins); Harold Schiffman, Ph.D. (Princeton); John Staddon, Ph.D. (Harvard), *Director of Graduate Studies*; Michael A. Wallach, Ph.D. (Harvard); Cliff Waldron Wing, Jr., Ph.D. (Tulane).

### Associate Professors

John C. Coie, Ph.D. (California at Berkeley); Robert Costanzo, Ph.D. (Florida); Carl John Erickson, Ph.D. (Rutgers); William C. Hall, Ph.D. (Duke); John B. McConahay, Ph.D. (California at Los Angeles).

### Assistant Professors

David Aderman, Ph.D. (Wisconsin); Carol Eckerman, Ph.D. (Columbia); Gregory W. Fischer, Ph.D. (Michigan); William Kalat, Ph.D. (Pennsylvania); Irwin Kremen, Ph.D. (Harvard); Alan S. Levy, Ph.D. (Columbia); Thomas T. Norton, Ph.D. (California at Los Angeles); G. M. Robinson, Ph.D. (Chicago); Susan Roth, Ph.D. (Northwestern); Charles W. White, Ph.D. (Stanford).

### Lecturers

John H. Casseday, Ph.D. (Indiana); Herbert Floyd Crovitz, Ph.D. (Duke); W. Doyle Gentry, Ph.D. (Florida State); Gail R. Marsh, Ph.D. (Iowa); Ronald W. Oppenheim, Ph.D. (Talmage Lee Peele, M.D. (Duke); William Derek Shows, Ph.D. (Duke); George G. Somjen, M.D. (New Zealand); Lise Wallach, Ph.D. (Kansas); M. L. Wolbarsht, Ph.D. (Johns Hopkins).

### Courses of Instruction

- |                               |  |
|-------------------------------|--|
| 203. Sensation and Perception | 214, 215. Developmental Psychology         |
| 206. Comparative Psychology   | 216. Biological Psychology                 |
| 210. Cognitive Psychology     | 217. Social Psychology                     |
| 212. Human Memory             | 218. Research Methods in Social Psychology |
| 213. Adaptive Behavior        | 219. Neural Bases of Behavior              |

- 228. Visually Guided Behavior
- 230. Social Behavior of Animals
- 234. Seminar in Personality
- 238. Electroencephalogram and Psychological Function
- 245. Personality Theory I
- 246. Personality Theory II
- 253. Psychological Approaches to Public Policy Analysis
- 261. Science, Politics, and Government
- 271S. Selected Problems
- 273-274. Statistical Principles in Experimental Design
- 276. Neuroanatomical Basis of Sensory Physiology
- 280. Psychology as a Science
- 282. Introduction to Methods in Psychotherapy
- 283, 284. The History of Psychology
- 291. Seminar in Community Mental Health
- 293. Methods in Developmental Psychology
- 305. Psychopathology
- 306. Seminar in Developmental Psychology
- 309. Seminar in Learning
- 310. Seminar in Perception
- 313. Seminar on the Concept of the Reflex
- 314. Seminar in Instrumental Behavior
- 316. Seminar in Social Psychology
- 317. Seminar in Social Behavior
- 318. Seminar in Social Influence
- 319-320. Research-Clinical Tutorial
- 321. Seminar in Psychophysiology of Hearing
- 325. Seminar in Animal Behavior
- 327, 328. Foundations of Clinical Psychology
- 329-330. Pro-Seminar in Psychology
- 333, 334. Seminar: Behavioral Studies of the Brain
- 335-336. Clinical Inquiry I
- 337. Seminar in Sensory Discrimination
- 340. Group Processes and Sensitivity Training
- 343, 344. Clinical Inquiry II
- 347-348. Personality Assessment
- 350. Practicum in Psychological Research
- 393. Integrative and Clinical Neurophysiology

## Public Policy Sciences

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the degrees of Master of Arts in public policy sciences, and a doctoral or professional degree. Such a program is designed to foster in highly trained professionals the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees.

With the exception of those individuals already possessing doctoral or professional degrees, therefore, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that which their doctoral or professional degree would require.

The joint degree curriculum involves a minimum of ten courses, to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy-research sequence, in which the student works closely with faculty in tutorial or small group situations, stresses the development of analytical skills applicable to the broad range of policy arenas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies (109 Old Chemistry.)

### Professors

Edward Harvey Estes, Jr., M.D. (Emory); Joel Lawrence Fleishman, LL.B. (Yale), *Director*; Jerry F. Hough, Ph.D. (Harvard); David L. Lange, LL.B. (Illinois).

### Associate Professors

Robert D. Behn, Ph.D. (Harvard); Colin C. Blaydon, Ph.D. (Harvard); Jarir S. Dajani, Ph.D. (Northwestern); Henry G. Grabowski, Ph.D. (Princeton); Willis D. Hawley, Ph.D. (California at Berkeley), *Associate Director and Director of Graduate Studies*; John B. McConahay, Ph.D. (California at Los Angeles); David E. Price, B.D., Ph.D. (Yale).

### Assistant Professors

Peter R. Decker, Ph.D. (Columbia); Gregory W. Fischer, Ph.D. (Michigan); Lawrence C. Goodwyn, Ph.D. (Texas); Joseph Lipscomb, Jr., Ph.D. (Vanderbilt); Lester M. Salamon, Ph.D. (Harvard).

## Lecturers

Bruce R. Kuniholm, Ph.D. (Duke); Bruce L. Payne, M.A. (Yale); Deborah A. Stone, B.A. (Michigan).

## Courses of Instruction

- 204S. Ethics in Political Life
- 216S. Comparative Politics of the Welfare State
- 217. Microeconomics and Public Policymaking
- 219. The Politics of the Policy Process
- 221. Analytical Methods I: Decision Analysis for Public Policy Makers
- 222. Analytical Methods II: Data Analysis for Public Policy Makers
- 223S. Ethics and Policymaking
- 224. Applications of Administrative and Organizational Theory
- 231. Analytical Methods III: Evaluation of Public Programs and Policies
- 232. Analytical Methods IV: Regression and Simulation Techniques for Policy Analysis
- 233. Analytic Approaches to Bargaining, Cooperation, and Competition
- 246. Population Policy
- 247. Political Participation and Policy Outcomes
- 252S. National Security Policy
- 253. Psychological Approaches to Public Policy
- 254. Transportation Planning and Policy Analysis
- 255. Science, Politics, and Government
- 256. The Economics of Health Care
- 260S. Public Policy Research Seminar: The Administration of Justice
- 261S. Research Seminar: Health Policy
- 262S. Research Seminar: Communications I
- 263S. Public Policy Research Seminar: Urban and Regional Development Policy
- 264S. Public Policy Research Seminar: Topics in Public Policy I
- 270S. Humanistic Perspectives on Public Policy
- 271. The Uses of History in Public Policy-Making I
- 272. Poverty in Non-Urban America: An Historical Perspective on the Inadequacy of Public Policy
- 273. The Uses of History in Public Policy II
- 275. Class, Ethnicity and Social Policy
- 283. Congressional Policy-Making
- 391. Multinational Corporations Seminar
- 340-390. Public Policy Research Seminars

## Religion

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) Biblical studies; (2) historical studies; and (3) systematic and contemporary studies. They will be expected to take such courses in one or both of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

## Professors

Frank Baker, B.D., Ph.D. (Nottingham); W. Waldo Beach, B.D., Ph.D. (Yale); David Bradley, Ph.D. (Yale); Robert E. Cushman, B.D., Ph.D., L.H.D. (Yale); William David Davies, B.D., M.A., D.D. (Wales), *George Washington Ivey Professor of Advanced Studies and Research in Christian Origins*; Stuart C. Henry, B.D., Ph.D. (Duke); Frederick L. Herzog, Th.D. (Princeton); Creighton Lacy, B.D., Ph.D. (Yale); Thomas A. Langford, B.D., Ph.D. (Duke); Charles H. Long, Ph.D. (Chicago); Roland E. Murphy, S.T.D. (Catholic Univ.); Robert Osborn, B.D., Ph.D. (Drew); William H. Poteat, B.D., Ph.D. (Yale), *Chairman*; James L. Price, B.D., Ph.D. (Cambridge); D. Moody Smith, Jr., B.D., Ph.D. (Yale), *Director of Graduate Studies*; Harmon L. Smith, B.D., Ph.D. (Duke); Franklin W. Young, B.D., Ph.D. (Duke), *Amos Ragan Kearns Professor of New Testament and Patristic Studies*.

## Associate Professors

Lloyd Richard Bailey, Ph.D. (Yale); James H. Charlesworth, B.D., Ph.D. (Duke); Wesley A. Kort, B.D., Ph.D. (Chicago); Bruce B. Lawrence, Ph.D. (Yale); Eric M. Meyers, Ph.D. (Harvard); Harry B. Partin, B.D., Ph.D. (Chicago); Jill Raitt, Ph.D. (Chicago); Charles K. Robinson, B.D., Ph.D. (Duke); David Curtis Steinmetz, Th.D. (Harvard); Orval Wintermute, B.D., Ph.D. (Johns Hopkins).



## Assistant Professor

Roger J. Corless, Ph.D. (Chicago).

## BIBLICAL STUDIES

### Courses of Instruction

- 207. Second Hebrew
- 208. Second Hebrew
- 209. Old Testament Theology
- 220. Third Hebrew
- 221. Readings in Hebrew Biblical Commentaries
- 223A. Exegesis of the Hebrew Old Testament: Amos and Hosea
- 223B. Exegesis of the Hebrew Old Testament: Job
- 223C. Exegesis of the Hebrew Old Testament: Exodus
- 223D. Exegesis of the Hebrew Old Testament: Song of Songs
- 225. Living Issues in New Testament Theology
- 226A. Exegesis of the Greek New Testament I (Mark and Matthew)
- 226B. Exegesis of the Greek New Testament I (Romans)
- 226D. Exegesis of the Greek New Testament I (I and II Corinthians)
- 226E. The Gospel and Epistles of John
- 227A. Exegesis of the Greek New Testament II (Luke-Acts)
- 227B. Exegesis of the Greek and New Testament II (Galatians)
- 227C. Exegesis of the Greek New Testament II (The Pastoral Epistles)
- 228. The Theology of the Gospel and Epistles of John
- 237. History of the Ancient Near East
- 239. Introduction to Middle Egyptian
- 242. Life After Death in Semitic Thought
- 244. The Archeology of Palestine in Hellenistic-Roman Times
- 258. Coptic
- 302. Studies in the Intertestamental Literature
- 304. Aramaic
- 304A. Targumic Aramaic
- 306. Language and Literature of the Dead Sea Scrolls
- 307. Syriac
- 311. Pharisaic Judaism in the First Century
- 312. Pauline Theology
- 314. Judaism and Christianity in the New Testament
- 319. The Gospel According to St. Matthew in Recent Research
- 323A. Comparative Semitic I
- 323B. Comparative Semitic II
- 340-341. Seminar in the New Testament
- 345. The Epistle to the Hebrews in Recent Research
- 350-351. Old Testament Seminar
- 353. Seminar on Text Criticism
- 373-374. Elementary Akkadian
- 375-376. Elementary Ugaritic
- 401. Colloquium in Biblical Studies

## HISTORICAL STUDIES

- 206. Christian Mysticism in the Middle Ages
- 217. Islam in India
- 218. Religion in Japan
- 219. Augustine
- 236. Luther and the Reformation in Germany
- 238. Jewish Response to Christianity
- 241. Problems in Reformation Theology
- 246. Problems in Historical Theology
- 247. Readings in Latin Theological Literature
- 251. The Counter-Reformation and the Development of Catholic Dogma
- 260. Seminar: Wesley Studies
- 280. The History of Religions
- 282. Myth and Ritual
- 284. The Religion and History of Islam
- 285. The Vedic Tradition: Compilation and Interpretation
- 287. The Scriptures of Asia
- 288. Buddhist Thought and Practice
- 289. World Religions and Social Change
- 296. Religion on the American Frontier
- 308. Greek Patristic Texts
- 313. The Apostolic Fathers
- 315-316. Seminar: History of Religions
- 317. Seminar in the Greek Apologists
- 318. Seminar in the Greek Fathers
- 324. Readings in the History of Religion
- 334. Theology and Reform in the Later Middle Ages
- 335. The English Church in the Eighteenth Century
- 338. Calvin and the Reformation in Switzerland
- 339. The Radical Reformation
- 344. Zwingli and the Origins of Reformed Theology
- 384. Religious Dissent in American Culture
- 385. Religion in American Literature
- 391. Historical Types of Christian Ethics I
- 392. Historical Types of Christian Ethics II
- 395. Christian Thought in Colonial America
- 396. Liberal Traditions in American Theology

## SYSTEMATIC AND CONTEMPORARY STUDIES

- 210. Contemporary British Theology
- 211. Authority in Theology
- 212. Policy Making and Theological Ethics
- 214. The Christian Doctrine of Salvation
- 230. The Meaning of Religious Language
- 231. Seminar in Religion and Contemporary Thought
- 232. Religion and Literature: Perspectives and Methods
- 233. Modern Narrative and Religious Language

- 245. Ethics in World Religions
- 248. The Theology of Karl Barth
- 262. Marxist Ideology and Christian Faith
- 272. Topics in Comparative Theology
- 281. Phenomenology and Religion
- 292. Christian Ethics and International Relations
- 300. Systematic Theology
- 303. The New Hermeneutic and the Idea of History
- 320. Theology, Power, and Justice
- 322. Nineteenth Century European Theology
- 325. Philosophical Theology I
- 326. Philosophical Theology II
- 328. Twentieth Century European Theology
- 352. Seminar in Christian Theology
- 360. Special Problems in Religion and Culture
- 361. Language and Biblical Criticism
- 377. Contemporary American Dramatic Arts and Evolving Theological Forms
- 380. Existentialist Thought
- 383. Moral Theology in the Twentieth Century
- 286. Christianity in Dialogue with Other Faiths
- 388. Ethics and Medicine
- 389. Christian Ethics and Contemporary Culture
- 390. Current Problems in Christian Ethical Theory
- 394. Christianity and the State
- 397. Contemporary American Theology
- 398. Colloquium on the College and University Teaching of Religion

## Romance Languages

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. will take related work in a second Romance language; however, related work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

### Professors

Thomas Howard Cordle, Ph.D. (Yale); Gifford Davis, Ph.D. (Harvard); John Morton Fein, Ph.D. (Harvard); Wallace Fowlie, Ph.D. (Harvard); Robert Niess, Ph.D. (Minnesota); Richard Lionel Predmore, D.M.L. (Middlebury); Marcel Tetel, Ph.D. (Wisconsin), *Chairman*; Bruce W. Wardropper, Ph.D. (Pennsylvania), *William H. Wannamaker Professor of Romance Languages*

### Associate Professors

Miguel Garci-Gomez, Ph.D. (Catholic Univ.); Alexander Hull, Ph.D. (Washington); Phillip Stewart, Ph.D. (Yale); Patrick R. Vincent, Ph.D. (Johns Hopkins), *Director of Graduate Studies*.

### Assistant Professors

Ernesto Caserta, Ph.D. (Harvard); Sarah Fielding, Ph.D. (Chicago), Richard L. Landeira, Ph.D. (Indiana).

## FRENCH

### Courses of Instruction

- 210. The Structure of French
- 213, 214. French Literature of the Seventeenth Century
- 217. French Symbolism
- 219. Old French Literature
- 220. French Pre-Romantic and Romantic Poetry
- 221, 222. The Nineteenth Century French Novel
- 223. Structuralism and the New Criticism
- 224. History of the French Language
- 225. French Prose of the Sixteenth Century
- 226. French Poetry of the Sixteenth Century
- 228. French Poetry of the Twentieth Century
- 233. Contemporary French Theater
- 234. Proust
- 241, 242. French Literature of the Eighteenth Century
- 245, 246. French Literature of the Twentieth Century
- 311, 312. French Seminar
- Graduate Reading Course

## ITALIAN

- 283. Italian Novel of the Novecento
- 284. Dante
- 285. Dante
- 288. The Renaissance

## SPANISH

- 251. The Origins of Spanish Prose Fiction
- 252. Spanish Lyric Poetry Before 1700

- 253. The Origins of the Spanish Theater
- 255, 256. Modern and Contemporary Spanish American Literature
- 257. Old Spanish Language
- 258. Medieval Literature
- 259. Spanish Phonetics
- 260. Orgins and Development of Spanish Romanticism
- 261. Nineteenth Century Novel
- 262. Galdós.
- 265. Cervantes
- 266. Drama of the Golden Age
- 275, 276. Contemporary Spanish Literature
- 321, 322. Hispanic Seminar

ROMANCE LANGUAGES

- 218. The Teaching of Romance Languages

Slavic Languages and Literatures

The Department of Slavic Languages and Literatures inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

Professor

Magnus J. Krynski, Ph.D. (Columbia), *Chairman.*

Associate Professor

Bronislas de Leval Jezierski, Ph.D. (Harvard), *Director of Graduate Studies.*

Courses of Instruction

- 201, 202. Russian Novel of the Nineteenth Century
- 205. The Structure of Polish in Relation to Russian
- 206. Readings in Contemporary Polish Prose in the Original
- 207. Soviet Literature and Culture
- 207P. Preceptorial
- 212. Pushkin
- 225S. Tolstoy
- 227S. Gogol
- 230. Chekhov
- 230P. Preceptorial
- 232. Dostoevsky
- 236. Russian and Polish Romanticism

Sociology

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Increasingly the department is concentrating its training in three programs: Sociology of Human Development; Demography and Ecology; and Social Structure and Social Change. Students who enter without having chosen a program have their first year to do so if entering with the Bachelor's degree or their first semester if entering with a Master's degree. Each program has its own course requirements, but all share a six-course requirement covering theory (281) and methodology (295), research methods and techniques (291, 292), and statistics (293, 294). In addition, each program has an informal seminar series and expects extensive student involvement in the research activities of program faculty. All students are expected to participate for training purposes in the teaching program of the department. In order to assure some breadth of training, all students are required to take at least two departmental courses outside the specific course requirements of both their chosen program and the departmental core requirement. Two or four additional courses outside the department in related work are also required.

There is a qualifying procedure after three semesters, or the equivalent, to determine whether the student can proceed to the preliminary examination. The latter is an oral examination on a written paper that reviews substantive, theoretical, and empirical aspects of a special field chosen by the student and accepted by the student's examining committee. Further details concerning the general departmental program, the three spe-

cialized programs, departmental facilities, the staff, ongoing research, and various stipends available may be obtained from the Director of Graduate Studies.

### Professors

Kurt W. Back, Ph.D. (Massachusetts Inst. of Tech.); Alan C. Kerckhoff, Ph.D. (Wisconsin), *Chairman*; George L. Maddox, Jr., Ph.D. (Michigan State); John C. McKinney, Ph.D. (Michigan State); George C. Myers, Ph.D. (Washington); Erdman B. Palmore, Ph.D. (Columbia); Alejandro Portes, Ph.D. (Wisconsin); Jack H. Preiss, Ph.D. (Michigan State); Donald F. Roy, Ph.D. (Chicago); Joel Smith, Ph.D. (Northwestern), *Director of Graduate Studies*; Edward A. Tiryakian, Ph.D. (Harvard).

### Associate Professors

James S. House, Ph.D. (Michigan); Ida Simpson, Ph.D. (North Carolina at Chapel Hill); John Wilson, D.Phil. (Oxford).

### Assistant Professors

Jeannie M. Baldigo, Ph.D. (Indiana); Richard T. Campbell, Ph.D. (Wisconsin); Mark Evers, Ph.D. (Michigan); Charles Hirschman, Ph.D. (Wisconsin); Willie Rice, Ph.D. (North Carolina at Chapel Hill).

### Courses of Instruction

- |   |  |
|---|--|
| 225. Medical Sociology                            | 298S, 299S. Seminar in Selected Topics                               |
| 230. Social Aspects of Aging and Death            | 301. Seminar in Human Fertility                                      |
| 241. Social Stratification                        | 302. Seminar in Migration  |
| 242. The Sociology of Occupations and Professions | 325. Social Aspects of Mental Illness and Treatment                  |
| 243. Population Dynamics and Social Change        | 341. Special Problems of Complex Systems                             |
| 244. Human Ecology and Urban Systems              | 344. Workshop on Computer Models of Social Systems                   |
| 246. Population Policy                            | 345, 346. Demographic Techniques I and II                            |
| 251. The Sociology of Modernization               | 349, 350. Seminar in Selected Topics of Demography and Ecology       |
| 255. Race and Culture                             | 351, 352. Seminar in Social Organization                             |
| 259. Religion and Social Change                   | 373, 374. Social Psychological Issues in Sociology                   |
| 260. Science, Technology, and Society             | 385. Seminar in Sociological Theory                                  |
| 261. Science, Politics, and Government            | 386. Seminar in Sociological Theory                                  |
| 272. The Socialization Process                    | 390. Seminar in Field Methods of Sociological Research               |
| 275. Social Structure and Personality             | 392. Individual Research in Sociology                                |
| 276. Small Groups and Social Life                 | 397, 398. Seminar in Special Research                                |
| 278. Social Structure and the Life Cycle          | 402. Interdisciplinary Seminar in the History of the Social Sciences |
| 281. Seminar in Sociological Theory               |  |
| 291. Research Methods and Techniques I            |  |
| 292. Research Methods and Techniques II           |  |
| 293. Introductory Statistical Analysis            |  |
| 294. Intermediate Statistical Analysis            |  |
| 295. Methodology in Sociology                     |  |

## Zoology

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the official detailed *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention, perhaps, should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physics, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.



**Professors**

Joseph R. Bailey, Ph.D. (Michigan); Cazlyn G. Bookhout, Ph.D. (Duke); John D. Costlow, Jr., Ph.D. (Duke); Donald J. Fluke, Ph.D. (Yale), *Chairman*; Nichols W. Gillham, Ph.D. (Harvard); John R. Gregg, Ph.D. (Princeton); Peter H. Klopfer, Ph.D. (Yale); Daniel A. Livingstone, Ph.D. (Yale); R. Bruce Nicklas, Ph.D. (Columbia); Knut Schmidt-Nielsen, Dr. Phil. (Copenhagen), *James B. Duke Professor of Physiology in Zoology*; Vance A. Tucker, Ph.D. (California at Los Angeles); Karl M. Wilbur, Ph.D. (Pennsylvania), *James B. Duke Professor of Zoology*.

**Associate Professors**

Richard T. Barber, Ph.D. (Stanford); John G. Lundberg, Ph.D. (Michigan); John P. Sutherland, Ph.D. (California at Berkeley); Stephen A. Wainwright, Ph.D. (California), *Director of Graduate Studies*; Calvin L. Ward, Ph.D. (Texas).

**Adjunct Associate Professor**

Klaus Schmidt-Koenig, Ph.D. (Freiburg).

**Assistant Professors**

Richard B. Forward, Ph.D. (California at Santa Barbara); David R. McClay, Ph.D. (North Carolina at Chapel Hill); Kenneth Storey, Ph.D. (British Columbia); H. Wilbur, Ph.D. (Michigan).

**Courses of Instruction**

201L. Animal Behavior	254S. Fluid Flow and Living Systems
202L. Introduction to Comparative Behavior	258L. Laboratory Research Methods
203L. Marine Ecology	260. Advanced Cell Biology
204L. Population and Community Ecology	262L. Cytological Materials and Methods
205. Elements of Theoretical Biology	265S, 266S. Seminar in Chromosome Biology
214L. Biological Oceanography	274L. Marine Invertebrate Zoology
216L. Limnology	275L. Invertebrate Zoology
218L. Paleobiology	277L. Endocrinology of Marine Animals
224L. Vertebrate Natural History	278L. Invertebrate Embryology
229. Morphogenetic Systems	280. Principles of Genetics
235. Evolutionary Systematics	286. Evolutionary Mechanisms
235L. Evolutionary Systematics	288S. The Cell in Development and Heredity
238L. Systematic Zoology	295S, 296S. Seminar
239S. Biogeography	351, 352. Departmental Seminar
245. Radiation Biology	353, 354. Research
246. Physical Biology	355, 356. Seminar
250L. Physiological Ecology of Marine Animals	360, 361. Tutorials
252. Comparative Physiology	

# MAP OF DUKE UNIVERSITY

## East Campus

- |                           |                        |
|---------------------------|------------------------|
| A Baldwin Auditorium      | O Pegram House         |
| B Bassett House           | P Duke Press           |
| C Brown House             | Q Infirmary            |
| D Union Building          | R Ark                  |
| E Faculty Apartments      | S Crowell Building     |
| F Art Museum, Geology     | T Epworth Inn          |
| G Aycock House            | U Gilbert-Addams House |
| H East Duke Building      | V Southgate Hall       |
| I West Duke Building      | W Campus Center        |
| J Jarvis House            | X Woman's College      |
| K Carr Building           | Y Asbury Building      |
| L Giles House             | Z Bivins Building      |
| M Woman's College Library | AA Art Building        |
| N Alsapha House           | BB Branson Building    |



## West Campus

- |                          |                          |                      |                          |
|--------------------------|--------------------------|----------------------|--------------------------|
| A Duke Chapel            | H Hospital Main Entrance | O Craven Quadrangle  | V Card Gymnasium         |
| B Divinity School        | I Gerontology, D & T,    | P Wannamaker Hall    | W Indoor Stadium         |
| C Gray Building          | Clinical Research        | Q Crowell Quadrangle | X School of Law          |
| D Perkins Library        | J Duke Hospital          | R Clock Tower Court  | Y Gross Chemical Lab     |
| E Language Center        | K Sociology, Psychology  | S Kilgo Quadrangle   | Z Biological Sciences    |
| F Old Chemistry Building | L Social Sciences        | T Union Building     | AA Plant Environment     |
| G Dawson Building        | M Allen Building         | U Flowers Building   | Laboratory               |
| School of Medicine       | N Few Quadrangle         | Page Auditorium      | BB Physics Building      |
|                          |                          |                      | CC Nuclear Laboratory    |
|                          |                          |                      | DD School of Engineering |
|                          |                          |                      | EE Army Research         |
|                          |                          |                      | FF Medical Center Res    |
|                          |                          |                      | Buildings                |
|                          |                          |                      | GG Nanaline H. Duke M    |
|                          |                          |                      | Sciences Building        |
|                          |                          |                      | HH Warehouse, Shop       |
|                          |                          |                      | II Bell Building         |
|                          |                          |                      | JJ Hanes House           |
|                          |                          |                      | School of Nursing        |
|                          |                          |                      | KK Hanes House Annex     |
|                          |                          |                      | LL Pickens Rehabitat     |
|                          |                          |                      | Center                   |
|                          |                          |                      | MM Graduate Center       |
|                          |                          |                      | NN Alumni House          |
|                          |                          |                      | OO Commonwealth Stud     |
|                          |                          |                      | Center                   |
|                          |                          |                      | PP Personnel Office      |
|                          |                          |                      | QQ International House   |
|                          |                          |                      | RR Personnel Office      |
|                          |                          |                      | SS Education Improvem    |
|                          |                          |                      | Program                  |
|                          |                          |                      | A Better Chance Pro      |
|                          |                          |                      | Center                   |
|                          |                          |                      | UU Campus Stores Off     |
|                          |                          |                      | VV Office of Institution |
|                          |                          |                      | Advancement              |
|                          |                          |                      | WW Information Service   |
|                          |                          |                      | Visitors Bureau          |
|                          |                          |                      | XX Admissions Office     |
|                          |                          |                      | YY Edens Quadrangle      |
|                          |                          |                      | ZZ Wade Stadium          |





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# Bulletin of Duke University

Graduate  
School

1976-1977





# **Bulletin of Duke University**

**Graduate School**

**1976-1977**

**Durham, North Carolina 1976**

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson

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Elizabeth Matheson

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## Contents

Calendar of the Graduate School	iv
University Administration	vii
Instructional Staff	viii
<b>Program Information</b>	<b>1</b>
The Master's Degrees	1
The Doctoral Degrees	7
<b>Special and Cooperative Programs</b>	<b>15</b>
<b>Resources for Study</b>	<b>27</b>
The Libraries	27
Science Laboratories	29
<b>Student Life</b>	<b>37</b>
Living Accommodations	37
Services Available	38
Student Affairs	40
Research and Publications	41
Visiting Scholars	41
<b>Admission</b>	<b>43</b>
<b>Financial Information</b>	<b>47</b>
Tuition and Fees	47
Expenses	49
Fellowships and Scholarships	50
Assistantships	54
Loans	55
<b>Registration and Regulations</b>	<b>56</b>
Registration	57
Academic Regulations	57
Commencement	63
Standards of Conduct	63
<b>Study in the Summer</b>	<b>67</b>
<b>Courses of Instruction</b>	<b>69</b>
Degrees Conferred May 1975	212
Degrees Conferred September 1974	219
Index	223

## Calendar of the Graduate School 1976-1977

### 1976

#### March

29-30 Monday-Tuesday—Registration for fall and summer, 1976.

#### April

1 Thursday—Last day for submitting dissertations for Ph.D. and Ed.D. degrees.  
15 Thursday—Last day for applying to the summer session, Term I.  
15 Thursday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.  
19 Monday, 6:00 p.m.—Spring semester classes end.  
20-26 Tuesday-Monday—Reading period.  
27 Tuesday—Final examinations begin.

#### May

4 Tuesday—Final examinations end.  
8 Saturday—Commencement exercises begin.  
9 Sunday—Baccalaureate Services and Commencement exercises.  
11 Tuesday—Summer session begins.  
14 Friday—Final date for completing application for admission to the summer session, Term II.

#### June

11-12 Friday-Saturday—Final examinations for Term I.  
12 Saturday—Term I ends.  
12 Saturday—Completion of registration for Term II.  
14 Monday—First class day for Term II.

#### July

15-16 Thursday-Friday—Final examinations for Term II.  
16 Friday—Term II ends.  
16 Friday—Completion of registration for Term III.  
19 Monday—First class day for Term III.

#### August

2 Monday—Final day for filing with the Graduate School Office the Statement of Intention to complete requirements for an advanced degree during the summer session. If a thesis is to be presented, the title is to be filed at the same time as the Statement of Intention.  
13 Friday—Last day for submitting theses for advanced degrees.  
19-20 Thursday-Friday—Final examinations for Term III.  
20 Friday—Final date for completion of requirements for Graduate School degrees to be awarded September 1.  
20 Friday—Term III ends.

### Academic Year 1976-1977

30-31 Monday-Tuesday—Registration and matriculation of all new and nonregistered returning students in the Graduate School.  
30-31 Monday-Tuesday—Consultation with directors of graduate study concerning course programs.  
31 Tuesday, 9:00 a.m.—English examination for foreign students, 111 Biological Sciences Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)

## September

- 1 Wednesday—Final date of registration and matriculation of all new and nonregistered returning students in the Graduate School.
- 1 Wednesday—Final date of consultations with directors of graduate study concerning course programs.
- 7 Tuesday, 9:00 a.m.—Fall semester classes begin.
- 8 Wednesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
- 9-10 Thursday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
- 13-17 Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
- 17 Friday—Final date for changes in registration which involve adding courses, provided no reduction in fees is entailed.

## October

- 1 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.
- 8 Friday—Final date for change in registration resulting from passing a preliminary examination.

## November

- 1-2 Monday-Tuesday—Registration for spring, 1977.
- 23 Tuesday, 6:00 p.m.—Thanksgiving recess begins.
- 29 Monday, 9:00 a.m.—Classes are resumed.

## December

- 7 Tuesday, 6:00 p.m.—Fall semester classes end.
- 8-14 Wednesday-Tuesday—Reading period.
- 12 Sunday—Founders' Day.
- 15 Wednesday—Final examinations begin.
- 21 Tuesday—Final examinations end.

# 1977

## January

- 5 Wednesday, 2:00 p.m.—English examination for foreign students, 309 Flowers Building. (See chapter on Admission for section on Additional Procedures for Foreign Students.)
- 7 Friday—Registration for new and nonregistered returning students.
- 10 Monday, 9:00 a.m.—Spring semester classes begin.
- 11 Tuesday, 4:00-6:00 p.m.—Drop/Add begins. Indoor Stadium.
- 12-14 Wednesday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
- 17-21 Monday-Friday, 8:30-12:30 and 2:00-4:00 p.m.—Drop/Add continues.
- 21 Friday—Final date for changes in registration which involve adding courses, provided that no reduction in fees is entailed.

## February

- 1 Tuesday—Final date for filing with the Graduate School Office the Statement of Intention of receiving an advanced degree in May. Titles of theses and dissertations are to be filed concurrently with the Statement of Intention.
- 4 Friday—Final date for dropping course-seminar registration and adding equivalent units of research.
- 11 Friday—Final date for change in registration resulting from passing a preliminary examination.

## March

- 4 Friday—Spring recess begins.
- 14 Monday, 9:00 a.m.—Classes are resumed.
- 28-29 Monday-Tuesday—Registration for fall and summer, 1977.

## April

- 1 Friday—Last day for submitting dissertations for Ph.D. and Ed.D. degrees.
- 15 Friday—Last day for submitting theses for A.M., M.S., M.Ed., and M.A.T. degrees.
- 15 Friday—Last day for applying to the summer session, Term I, 1977.
- 18 Monday, 6:00 p.m.—Spring semester classes end.
- 19-25 Tuesday-Monday—Reading period.
- 26 Tuesday—Final examinations begin.

## May

- 2 Monday—Final examinations end.
- 7 Saturday—Commencement exercises begin.
- 8 Sunday—Baccalaureate Services and Commencement exercises.
- 13 Friday—Final date for completing application for admission to the summer session, Term II, 1977.





# University Administration

## General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*  
John O. Blackburn, Ph.D., *Chancellor*  
Frederic N. Cleaveland, Ph.D., *Provost*  
Charles B. Huestis, *Vice President for Business and Finance*  
William G. Anlyan, M.D., *Vice President for Health Affairs*  
Juanita M. Kreps, Ph.D., *Vice President*  
J. David Ross, J.D., *Vice President for Institutional Advancement*  
Victor A. Bubas, B.S., *Vice President for Community Relations*  
Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*  
J. Peyton Fuller, A.B., *Assistant Vice President and Controller*  
Harold W. Lewis, Ph.D., *Vice Provost and Dean of the Faculty*  
John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*  
John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*  
Ewald W. Busse, M.D., *Associate Provost and Director of Medical and Allied Health Education*  
John Shytle, M.S., *Director Pro Tem of Duke Hospitals*  
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*  
Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*  
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*  
William C. Turner, Jr. M.Div., *Assistant Provost and Dean of Black Affairs*  
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Black Affairs*  
Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*  
Connie R. Dunlap, A.M.L.S., *Librarian*  
William E. King, Ph.D., *University Archivist*  
Clark R. Cahow, Ph.D., *University Registrar*  
Olan Lee Petty, Ph.D., *Director of Summer Session*  
Rufus H. Powell, LL.B., *Secretary of the University*  
Charles Linn Haslam, J.D., *University Counsel*

## Graduate School Administration

John C. McKinney, Ph.D., *Dean of the Graduate School*  
William G. Katzenmeyer, Ed.D., *Associate Dean*  
Charles M. Harman, Ph.D., *Associate Dean*  
Pauline D. Myers, *Assistant to the Dean*  
Frances C. Thomas, A.B., *Administrative Assistant*

## Executive Committee of the Graduate Faculty

Dean John C. McKinney

Robert L. Barnes (Alt.)\*  
Anne Flowers (Alt.)  
Ernestine Friedl\*  
Henry Grabowski  
Walter R. Guild (Alt.)  
William R. Krigbaum (Alt.)  
Gregory R. Lockhead (Alt.)\*  
Francis Newton (Alt.)  
Holger O. Nygard\*  
Athos Ottolenghi  
Merrell L. Patrick (Alt.)\*  
George Pearsall  
Richard L. Predmore  
Seth L. Warner\*  
Hilda P. Willett\*  
Franklin W. Young (Alt.)\*

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\*Term expires September, 1976.

# Graduate School Faculty

(As of October 1, 1975.)

The date denotes the first year of service at Duke University.

- Anne H. Adams (1971), Ed.D., *Professor of Education*  
Dolph O. Adams (1972), M.D., Ph.D., *Assistant Professor of Pathology*  
Mark R. Adelman (1971), Ph.D., *Assistant Professor of Anatomy*  
David Aderman (1970), Ph.D., *Assistant Professor of Psychology*  
<sup>1</sup>John Richard Alden (1955), Ph.D., *James B. Duke Professor of History*  
Carol A. Aldrich (1970), Ph.D., *Assistant Professor of Business Administration*  
Irving Alexander (1963), Ph.D., *Professor of Psychology*  
William K. Allard (1975), Ph.D., *Professor of Mathematics*  
A. Tilo Alt (1961-65; 1967), Ph.D., *Professor of German*  
D. Bernard Amos (1962), M.D., *James B. Duke Professor of Immunology*  
<sup>2</sup>Carl Anderson (1955), Ph.D., *Professor of English*  
Lewis Edward Anderson (1936), Ph.D., *Professor of Botany*  
Nels C. Anderson, Jr. (1966), Ph.D., *Associate Professor of Physiology*  
Peter Anderson (1975), Ph.D., *Assistant Professor of Pathology*  
Roger Fabian Anderson (1950), Ph.D., *Professor of Forest Entomology*  
Janis Antonovics (1970), Ph.D., *Associate Professor of Botany*  
Stanley Hersh Appel (1964-65; 1967), M.D., *Associate Professor of Biochemistry*  
Mahadev L. Apte (1965), Ph.D., *Associate Professor of Anthropology*  
John Leslie Artley (1955), D.Eng., *Professor of Electrical Engineering*  
Kurt W. Back (1959), Ph.D., *Professor of Sociology*  
Rodger W. Baier (1972), Ph.D., *Assistant Professor of Chemistry*  
Joseph Randle Bailey (1946), Ph.D., *Professor of Zoology*  
<sup>3</sup>Lloyd Richard Bailey (1971), Ph.D., *Associate Professor of Old Testament*  
Frank Baker (1960), Ph.D., *Professor of English Church History*  
Kenneth R. Baker (1973), Ph.D., *Associate Professor of Business Administration*  
Jeannie M. Baldigo (1974), Ph.D., *Assistant Professor of Sociology*  
Steven W. Baldwin (1970), Ph.D., *Assistant Professor of Chemistry*  
Helmy Hamdollah Baligh (1967), Ph.D., *Professor of Business Administration*  
Robert H. Ballantyne (1962), Ed.D., *Associate Professor of Education*  
James David Barber (1972), Ph.D., *Professor of Political Science*  
Richard T. Barber (1970), Ph.D., *Associate Professor of Zoology and Associate Professor of Botany*  
Robert Lloyd Barnes (1965), Ph.D., *Professor of Forest Biochemistry*  
Roger C. Barr (1969), Ph.D., *Associate Professor of Biomedical Engineering*  
Joseph Battle (1970), Ph.D., *Associate Professor of Business Administration*  
William Waldo Beach (1946), Ph.D., *Professor of Christian Ethics*  
Robert D. Behn (1973), Ph.D., *Associate Professor of Public Policy Sciences*  
Robert M. Bell (1972), Ph.D., *Assistant Professor of Biochemistry*  
Jan A. Bergeron (1969), V.M.D., *Adjunct Assistant Professor of Anatomy*  
Charles W. Bergquist (1972), Ph.D., *Assistant Professor of History*  
William Bevan (1974), Ph.D., *William Preston Few Professor of Psychology*  
L. C. Biedenharn, Jr. (1961), Ph.D., *Professor of Physics*  
Alan Biermann (1974), Ph.D., *Assistant Professor of Computer Science*  
Darell D. Bigner (1972), M.D., Ph.D., *Associate Professor of Pathology*  
William Dwight Billings (1952), Ph.D., *James B. Duke Professor of Botany*  
<sup>4</sup>Edward George Bilpuch (1962), Ph.D., *Professor of Physics*  
John A. Bittikofer (1970), Ph.D., *Associate Professor in Biochemistry*  
John O. Blackburn (1962), Ph.D., *Professor of Economics*  
Charles A. Blake (1972), Ph.D., *Assistant Professor of Anatomy*  
William F. Blankley (1972), Ph.D., *Assistant Professor of Botany*  
Mary M. Blanks (1975), M.H.A., *Assistant Professor of Health Administration*  
Colin C. Blaydon (1975), Ph.D., *Associate Professor of Public Policy Sciences*  
J. J. Blum (1962), Ph.D., *Professor of Physiology*  
Bruce R. Bolnick (1974), Ph.D., *Assistant Professor of Economics*  
Dani P. Bolognesi (1971), Ph.D., *Associate Professor of Microbiology*

<sup>1</sup>Leave of absence, fall semester, 1975.

<sup>2</sup>Sabbatical leave, fall semester, 1975.

<sup>3</sup>Sabbatical leave, spring semester, 1976.

<sup>4</sup>Leave of absence, spring semester, 1975.

- Joseph Bonaventura (1972), Ph.D., *Associate in Biochemistry*  
 Cazlyn Green Bookhout (1935), Ph.D., *Professor of Zoology*  
 James Alexander Boon (1974), Ph.D., *Assistant Professor of Anthropology*  
 Frank Borchardt (1971), Ph.D., *Associate Professor of German*  
 Lloyd J. Borstelmann (1953), Ph.D., *Professor of Psychology*  
 Edward H. Bossen (1972), M.D., *Assistant Professor of Pathology*  
<sup>5</sup>John E. Boynton (1968), Ph.D., *Associate Professor of Botany*  
 William D. Bradford (1966), M.D., *Associate Professor of Pathology*  
 David G. Bradley (1949), Ph.D., *Professor of Religion*  
 Charles Kilgo Bradsher (1939), Ph.D., *James B. Duke Professor of Chemistry*  
 Ralph Braibanti (1953), Ph.D., *James B. Duke Professor of Political Science*  
 Eleanor F. Branch (1972), Ph.D., *Associate Professor of Physical Therapy*  
 Martin Bronfenbrenner (1971), Ph.D., *William R. Kenan, Jr. Professor of Economics*  
 Earl Ivan Brown, II (1960), Ph.D., *J. A. Jones Professor of Civil Engineering*  
 Montague Brown (1975), Dr. P. H., *Professor of Health Administration*  
 C. Edward Buckley, III (1963), M.D., *Associate Professor of Immunology*  
 Rebecca Buckley (1968), M.D., *Associate Professor of Immunology*  
 Louis J. Budd (1952), Ph.D., *Professor of English*  
 Donald S. Burdick (1962), Ph.D., *Associate Professor of Mathematics*  
 Peter H. Burian (1968), Ph.D., *Assistant Professor of Classical Studies*  
 R. O. Burns (1964), Ph.D., *Professor of Microbiology*  
 Richard M. Burton (1970), D.B.A., *Associate Professor of Business Administration*  
 Edmund Butler (1975), Ph.D., *Assistant Professor of Mathematics*  
 Ronald Richard Butters (1967), Ph.D., *Associate Professor of English*  
 Gale H. Buzzard (1957), Ph.D., *Assistant Professor of Mechanical Engineering and Materials Science*  
<sup>6</sup>Edwin H. Cady (1973), Ph.D., *Andrew W. Mellon Professor in the Humanities*  
 Philip Calkins (1973), Ph.D., *Assistant Professor of History*  
 Richard T. Campbell (1974), Ph.D., *Assistant Professor of Sociology*  
 Murray Cantor (1974), Ph.D., *Assistant Professor of Mathematics*  
 Peter F. Carbone (1966), Ed.D., *Associate Professor of Education*  
 Leonard Carlitz (1932), Ph.D., *James B. Duke Professor of Mathematics*  
 Adelaide T. C. Carpenter (1975), Ph.D., *Adjunct Assistant Professor of Anatomy*  
 Robert C. Carson (1960), Ph.D., *Professor of Psychology*  
 Reginald D. Carter (1970), Ph.D., *Assistant Professor of Physiology*  
<sup>7</sup>Matthew Cartmill (1969), Ph.D., *Associate Professor of Anatomy and Associate Professor of Anthropology*  
 William H. Cartwright (1951), Ph.D., *Professor of Education*  
 Ernesto Caserta (1970), Ph.D., *Assistant Professor of Romance Languages*  
 John H. Cassedy (1970), Ph.D., *Lecturer in Psychology*  
 Ronald W. Casson (1971), Ph.D., *Assistant Professor of Anthropology*  
 John Cell (1962), Ph.D., *Associate Professor of History*  
 Jack B. Chaddock (1966), Sc.D., *Professor of Mechanical Engineering and Materials Science*  
 William Chafe (1971), Ph.D., *Associate Professor of History*  
 Jagdish Chandra (1974), Ph.D., *Adjunct Associate Professor of Mathematics*  
 James H. Charlesworth (1969), Ph.D., *Associate Professor of Religion*  
 Donald B. Chesnut (1965), Ph.D., *Professor of Chemistry*  
 Norman L. Christensen (1973), Ph.D., *Assistant Professor of Botany*  
 Edgar W. Clark (1970), Ph.D., *Adjunct Associate Professor of Forest Entomology*  
 Howard G. Clark (1968), Ph.D., *Professor of Biomedical Engineering and Professor of Mechanical Engineering and Materials Science*  
 Frederic N. Cleaveland (1971), Ph.D., *Professor of Political Science*  
<sup>8</sup>John L. E. Clubbe (1966), Ph.D., *Associate Professor of English*  
 Franklin H. Cocks (1972), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*  
 Kalman J. Cohen (1974), Ph.D., *Distinguished Bank Research Professor of Business Administration*  
 John D. Coie (1968), Ph.D., *Associate Professor of Psychology*  
<sup>9</sup>Joel Colton (1947), Ph.D., *Professor of History*  
 Robert Merle Colver (1953), Ed.D., *Associate Professor of Education*  
 Frank J. Convery (1972), Ph.D., *Assistant Professor of Natural Resource Economics*  
 Thomas Howard Cordle (1950), Ph.D., *Professor of Romance Languages*  
 Joseph M. Corless (1974), M.D., Ph.D., *Assistant Professor of Anatomy*

<sup>5</sup>Sabbatical leave, academic year, 1975-76.

<sup>6</sup>Sabbatical leave, academic year, 1975-76.

<sup>7</sup>Sabbatical leave, spring semester, 1976.

<sup>8</sup>Sabbatical leave, academic year, 1975-76.

<sup>9</sup>Leave of absence, academic year, 1975-76.

- Roger J. Corless (1973), Ph.D., Assistant Professor of Religion  
Philip Robert Costanzo (1968), Ph.D., Associate Professor of Psychology  
John D. Costlow, Jr. (1959), Ph.D., Professor of Zoology  
Shelia J. Counce (1968), Ph.D., Associate Professor of Anatomy  
Peter Cresswell (1974), Ph.D., Assistant Professor of Immunology  
Herbert F. Crovitz (1963), Ph.D., Lecturer in Psychology  
Alvin L. Crumbliss (1970), Ph.D., Assistant Professor of Chemistry  
William Louis Culberson (1955), Ph.D., Professor of Botany  
Robert Earle Cushman (1945), Ph.D., Research Professor of Systematic Theology  
Ronald Y. Cusson (1970), Ph.D., Associate Professor of Physics  
Jarir Dajani (1971), Ph.D., Associate Professor of Civil Engineering, Associate Professor of Environmental Studies, and Associate Professor of Public Policy Sciences  
William W. Damon (1970), Ph.D., Assistant Professor of Business Administration  
Charles Daniels (1970), M.D., Ph.D., Associate Professor of Pathology  
David G. Davies (1961), Ph.D., Professor of Economics  
William D. Davies (1966), D.D., George Washington Ivey Professor of Advanced Studies and Research in Christian Origins  
Calvin D. Davis (1962), Ph.D., Associate Professor of History  
Gifford Davis (1930), Ph.D., Professor of Romance Language  
Lucy T. Davis (1969), Ed.D., Associate Professor of Education  
Jeffrey R. Dawson (1969), Ph.D., Assistant Professor of Immunology  
Eugene Davis Day (1962), Ph.D., Professor of Immunology  
Peter R. Decker (1975), Ph.D., Assistant Professor of Policy Sciences  
Thomas J. Delaney (1974), M.S., Assistant Professor of Health Administration  
<sup>10</sup>David C. Dellinger (1968), Ph.D., Associate Professor of Business Administration  
Frank C. DeLucia (1969), Ph.D., Assistant Professor of Physics  
Neil de Marchi (1971), Ph.D., Associate Professor of Economics  
<sup>11</sup>A. Leigh DeNeef (1969), Ph.D., Associate Professor of English  
Irving Diamond (1958), Ph.D., James B. Duke Professor of Psychology and Lecturer in Anatomy  
Joseph Di Bona (1967), Ph.D., Associate Professor of Education  
Arif Dirlik (1973), Ph.D., Assistant Professor of History  
Bernard I. Duffey (1963), Ph.D., Professor of English  
Kenneth Lindsay Duke (1940), Ph.D., Associate Professor of Anatomy  
Walter Nunez Duran (1974), Ph.D., Adjunct Assistant Professor of Physiology and Pharmacology  
Robert F. Durden (1952), Ph.D., Professor of History  
<sup>12</sup>George Jiri Dvorak (1967), C.Sc., Ph.D., Professor of Civil Engineering  
Carol Eckerman (1973), Ph.D., Assistant Professor in Psychology  
Jane G. Elchlepp (1960), M.D., Ph.D., Associate Professor of Pathology  
Albert Eldridge (1970), Ph.D., Assistant Professor of Political Science  
Everett H. Ellinwood, Jr. (1966), M.D., Assistant Professor of Pharmacology  
Ernest Elsevier (1950), M.S., Associate Professor of Mechanical Engineering and Materials Science  
Carl Erickson (1966), Ph.D., Associate Professor of Psychology  
Harold P. Erickson (1970), Ph.D., Assistant Professor of Anatomy  
Robert P. Erickson (1961), Ph.D., Professor of Psychology  
E. Harvey Estes (1953), M.D., Professor of Public Policy Sciences  
Evan A. Evans (1973), Ph.D., Associate Professor of Biomedical Engineering and Assistant Professor of Experimental Orthopaedics  
Lawrence E. Evans (1963), Ph.D., Associate Professor of Physics  
John Wendell Everett (1932), Ph.D., Professor of Anatomy  
Mark Evers (1974), Ph.D., Assistant Professor of Sociology  
Henry A. Fairbank (1962), Ph.D., Professor of Physics  
David J. Falcone (1975), Ph.D., Assistant Professor of Health Administration  
John Morton Fein (1950), Ph.D., Professor of Romance Languages  
Robert E. Fellows, Jr. (1966), M.D., Ph.D., Associate Professor of Physiology  
Arthur Bowles Ferguson (1939), Ph.D., Professor of History  
Oliver W. Ferguson (1957), Ph.D., Professor of English  
Bernard F. Fetter (1951), M.D., Professor of Pathology  
Sara Fielding (1975), Ph.D., Assistant Professor of Romance Languages  
Gregory Warren Fischer (1973), Ph.D., Assistant Professor of Psychology and Assistant Professor of Public Policy Sciences  
<sup>13</sup>Peter G. Fish (1969), Ph.D., Associate Professor of Political Science

<sup>10</sup>Sabbatical leave, fall semester, 1975.

<sup>11</sup>Sabbatical leave, fall semester, 1975.

<sup>12</sup>Sabbatical leave, academic year, 1975-76.

<sup>13</sup>Sabbatical leave, fall semester, 1975.



- Joel Fleishman (1971), LL.M., *Professor of Law and Professor of Public Policy Sciences*  
 William H. Fletcher (1974), Ph.D., *Assistant Professor of Anatomy*  
 Anne Flowers (1972), Ed.D., *Professor of Education*  
 Donald J. Fluke (1958), Ph.D., *Professor of Zoology*  
 Lloyd R. Fortney (1964), Ph.D., *Associate Professor of Physics*  
 Richard B. Forward (1971), Ph.D., *Assistant Professor of Zoology*  
 Derrell Foster (1974), Ph.D., *Assistant Professor of Computer Science*  
 Wallace Fowlie (1964), Ph.D., *James B. Duke Professor of Romance Languages*  
 Richard G. Fox (1968), Ph.D., *Professor of Anthropology*  
 Irwin Fridovich (1958), Ph.D., *Professor of Biochemistry*  
<sup>14</sup>Ernestine Friedl (1973), Ph.D., *Professor of Anthropology*  
 Zvi Friedman (1975), Ph.D., *Assistant Professor of Physics*  
<sup>15</sup>William J. Furbish (1954), M.S., *Associate Professor of Geology*  
 Thomas M. Gallie, Jr. (1954-55; 1956), Ph.D., *Professor of Computer Science*  
 Miguel Garcí-Gómez (1973), Ph.D., *Associate Professor of Romance Languages*  
 Devendra P. Garg (1972), Ph.D., *Professor of Mechanical Engineering and Materials Science*  
 Raymond Gavins (1970), Ph.D., *Assistant Professor of History*  
 W. Scott Gehman, Jr. (1954), Ph.D., *Professor of Psychology in Education*  
 W. Doyle Gentry (1969), Ph.D., *Lecturer in Psychology*  
 Rhett Triesdale George, Jr. (1957), Ph.D., *Assistant Professor of Electrical Engineering*  
 Gerald E. Gerber (1962), Ph.D., *Associate Professor of English*  
 Susan Gerhart (1973), Ph.D., *Assistant Professor of Computer Science*  
 Nicholas W. Gillham (1968), Ph.D., *Professor of Zoology*  
 Sherwood Githens (1962), Ph.D., *Professor of Education*  
 Kenneth E. Glander (1975), Ph.D., *Assistant Professor of Anthropology*  
<sup>16</sup>Craufurd Goodwin (1962), Ph.D., *James B. Duke Professor of Economics*  
 Lawrence C. Goodwyn (1971), Ph.D., *Assistant Professor of Public Policy Sciences and Adjunct Assistant Professor of History*  
 Walter Gordy (1946), Ph.D., LL.D., D.H.C., *James B. Duke Professor of Physics*  
 Alfred T. Goshaw (1973), Ph.D., *Assistant Professor of Physics*  
<sup>17</sup>Henry G. Grabowski (1972), Ph.D., *Associate Professor of Economics and Associate Professor of Policy Sciences*  
 Daniel A. Graham (1969), Ph.D., *Associate Professor of Economics*  
 Doyle G. Graham (1970), M.D., Ph.D., *Assistant Professor of Pathology*  
 Ronald C. Greene (1958), Ph.D., *Associate Professor of Biochemistry*  
 Joseph C. Greenfield (1962), M.D., *Assistant Professor of Physiology and Pharmacology*  
 John R. Gregg (1957), Ph.D., *Professor of Zoology*  
 Samson R. Gross (1960), Ph.D., *Professor of Genetics and Biochemistry*  
 Kazimierz Grzybowski (1967), S.J.D., *Professor of Political Science*  
 Walter R. Guild (1960), Ph.D., *Professor of Biochemistry*  
 Allan Gut (1975), Ph.D., *Visiting Associate Professor of Mathematics*  
 John W. Gutknecht (1969), Ph.D., *Associate Professor of Physiology and Pharmacology*  
 William P. Gutknecht (1971), Ph.D., *Assistant Professor of Chemistry*  
 Norman Guttman (1951), Ph.D., *Professor of Psychology*  
 Robert L. Habig (1969), Ph.D., *Assistant Professor of Biochemistry*  
 Donald B. Hackel (1960), M.D., *Professor of Pathology*  
 Herbert Hacker, Jr. (1965), Ph.D., *Associate Professor of Electrical Engineering*  
 Dwight H. Hall (1968), Ph.D., *Adjunct Assistant Professor of Biochemistry*  
 Hugh Marshall Hall, Jr. (1952), Ph.D., *Professor of Political Science*  
 James Ewbank Hall (1973), Ph.D., *Assistant Professor of Physiology*  
 William C. Hall (1970), Ph.D., *Associate Professor of Anatomy and Assistant Professor of Psychology*  
 John Hamilton Hallowell (1942), Ph.D., *James B. Duke Professor of Political Science*  
 William E. Hammond (1963), Ph.D., *Associate Professor of Biomedical Engineering and Associate Professor of Community Health Sciences*  
 Moo-Young Han (1967), Ph.D., *Associate Professor of Physics*  
 Charles Morgan Harman (1961), Ph.D., *Professor of Mechanical Engineering and Materials Science*  
 Jerome S. Harris (1936), M.D., *Professor of Biochemistry*  
 Gerald Hartwig (1970), Ph.D., *Associate Professor of History*  
 Thomas M. Havrilesky (1969), Ph.D., *Associate Professor of Economics*  
 Hal K. Hawkins (1973), M.D., Ph.D., *Assistant Professor of Pathology*

<sup>14</sup>Leave of absence, spring semester, 1976.

<sup>15</sup>Sabbatical leave, fall semester, 1975.

<sup>16</sup>Leave of absence, half-time, academic year, 1975-76.

<sup>17</sup>Leave of absence, spring semester, 1976.

- Willis D. Hawley (1972), Ph.D., Associate Professor of Policy Sciences and Associate Professor of Political Science
- Milton Heath (1975), LL.B., Adjunct Associate Professor of Environmental Law
- Henry Hellmers (1965), Ph.D., Professor of Botany and Professor of Forestry
- <sup>18</sup>Robert William Henkens (1968), Ph.D., Associate Professor of Chemistry
- Stuart C. Henry (1959), Ph.D., Professor of American Christianity
- Duncan Heron (1950), Ph.D., Professor of Geology
- Frederick Herzog (1960), Th.D., Professor of Systematic Theology
- Robert L. Hill (1961), Ph.D., James B. Duke Professor of Biochemistry
- Charles H. Hirschman (1972), Ph.D., Assistant Professor of Sociology
- George H. Hitchings (1971), Ph.D., Professor of Pharmacology
- Marcus Edwin Hobbs (1935), Ph.D., Professor of Chemistry
- Richard Earl Hodel (1965), Ph.D., Associate Professor of Mathematics
- Charles S. Hodges, Jr. (1970), Ph.D., Adjunct Associate Professor of Forest Pathology
- Irving E. Holley, Jr. (1947), Ph.D., Professor of History
- Frederic B. M. Hollyday (1956), Ph.D., Professor of History
- Ole R. Holsti (1974), Ph.D., George V. Allen Professor of Political Science
- <sup>19</sup>Everett H. Hopkins (1961), M.A., LL.D., Professor of Education
- Jerry F. Hough (1973), Ph.D., Professor of Political Science and Professor of Policy Sciences
- James S. House (1970), Ph.D., Associate Professor of Sociology
- <sup>20</sup>Alexander Hull (1962), Ph.D., Associate Professor of Romance Languages
- Allan S. Hurlburt (1956), Ph.D., Professor of Education
- William L. Hylander (1971), Ph.D., Associate Professor of Anatomy and Associate Professor of Anthropology
- Wallace Jackson (1965), Ph.D., Associate Professor of English
- Boi Jon Jaeger (1971), Ph.D., Associate Professor of Health Administration
- Peter W. Jeffs (1964), Ph.D., Professor of Chemistry
- Marianna Jenkins (1948), Ph.D., Professor of Art
- Robert B. Jennings (1975), M.D., Professor of Pathology
- Bronislas de Leval Jezierski (1958), Ph.D., Associate Professor of Slavic Languages and Literatures
- Frans F. Jöbsis (1964), Ph.D., Professor of Physiology
- Sheridan Johns, III (1970), Ph.D., Associate Professor of Political Science
- Charles B. Johnson (1956), Ed.D., Associate Professor of Education
- Edward A. Johnson (1963), M.D., Professor of Physiology and Pharmacology
- Kurt E. Johnson (1971), Ph.D., Assistant Professor of Anatomy
- Terry W. Johnson, Jr. (1954), Ph.D., Professor of Botany
- William W. Johnston (1963), M.D., Professor of Pathology
- William Thomas Joines (1966), Ph.D., Associate Professor of Electrical Engineering
- Wolfgang Karl Joklik (1968), D.Phil., James B. Duke Professor of Microbiology and Immunology
- Buford Jones (1962), Ph.D., Associate Professor of English
- Edward Ellsworth Jones (1953), Ph.D., Professor of Psychology
- James Kalat (1971), Ph.D., Assistant Professor of Psychology
- Henry Kamin (1948), Ph.D., Professor of Biochemistry
- William G. Katzenmeyer (1967), Ed.D., Professor of Education
- Bernard Kaufman (1968), Ph.D., Associate Professor of Biochemistry
- Richard F. Kay (1973), Ph.D., Assistant Professor of Anatomy
- <sup>21</sup>Thomas F. Keller (1959), Ph.D., R. J. Reynolds Professor of Business Administration
- Allen C. Kelley (1972), Ph.D., Professor of Economics
- <sup>22</sup>Van Leslie Kenyon, Jr. (1945), M.M.E., Professor of Mechanical Engineering and Materials Science
- Alan C. Kerckhoff (1958), Ph.D., Professor of Sociology
- Robert B. Kerr (1965), Ph.D., Professor of Electrical Engineering
- Sung-Hou Kim (1970), Ph.D., Associate Professor of Biochemistry
- Thomas DeArman Kinney (1960), M.D., Professor of Pathology
- Norman Kirshner (1956), Ph.D., Professor of Biochemistry
- Joseph Weston Kitchen, Jr. (1962), Ph.D., Associate Professor of Mathematics
- Gordon K. Klintworth (1964), M.D., Ph.D., Professor of Pathology
- <sup>23</sup>Peter H. Klopfer (1958), Ph.D., Professor of Zoology
- Kenneth R. Knoerr (1961), Ph.D., Professor of Forest Meteorology and Associate Professor of Botany
- J. Mailen Kootsey (1969), Ph.D., Adjunct Assistant Professor of Physiology and Pharmacology

<sup>18</sup>Sabbatical leave, fall semester, 1975.

<sup>19</sup>Sabbatical leave, fall semester, 1975.

<sup>20</sup>Sabbatical leave, spring semester, 1976.

<sup>21</sup>Sabbatical leave, June 15, 1975 through November 15, 1975.

<sup>22</sup>Sabbatical leave, fall semester, 1975.

<sup>23</sup>Sabbatical leave, spring semester, 1976.

- Allan Kornberg (1965), Ph.D., *Professor of Political Science*  
 Wesley A. Kort (1965), Ph.D., *Associate Professor of Religion*  
 David Paul Kraines (1970), Ph.D., *Associate Professor of Mathematics*  
 Nicholas Michael Kredich (1968), M.D., *Assistant Professor of Biochemistry*  
 Irwin Kremen (1963), Ph.D., *Assistant Professor of Psychology*  
 Juanita M. Kreps (1955), Ph.D., *James B. Duke Professor of Economics*  
 William B. Krigbaum (1952), Ph.D., *James B. Duke Professor of Chemistry*  
 Magnus Jan Krynski (1966), Ph.D., *Professor of Slavic Languages and Literature*  
 Arthur J. Kuhn (1971), Ph.D., *Assistant Professor of Business Administration*  
 Johannes A. Kylstra (1965), M.D., Ph.D., *Associate Professor of Physiology*  
 Weston LaBarre (1946), Ph.D., *James B. Duke Professor of Anthropology*  
 Leon Lack (1965), Ph.D., *Professor of Physiology and Pharmacology*  
 Creighton Lacy (1953), Ph.D., *Professor of World Christianity*  
 Martin Lakin (1958), Ph.D., *Professor of Psychology*  
 Richard L. Landeira (1970), Ph.D., *Assistant Professor of Romance Languages*  
 David J. Lang (1974), M.D., *Assistant Professor of Microbiology*  
 David L. Lange (1971), LL.B., *Professor of Public Policy Sciences*
- <sup>24</sup>Karla Langedijk (1969), Ph.D., *Lecturer in Art History*  
 Thomas A. Langford (1956), Ph.D., *Professor of Systematic Theology*  
 Peter K. Lauf (1968), M.D., *Associate Professor of Physiology and Assistant Professor of Immunology*
- <sup>25</sup>Bruce B. Lawrence (1971), Ph.D., *Associate Professor of Religion*  
 Dewey T. Lawson (1974), Ph.D., *Assistant Professor of Physics*
- <sup>26</sup>Richard H. Leach (1955), Ph.D., *Professor of Political Science*
- <sup>27</sup>Harold E. Lebovitz (1959), M.D., *Assistant Professor of Physiology*  
 Jack A. Lees (1971), Ph.D., *Assistant Professor of Mathematics*  
 Robert Lefkowitz (1973), Ph.D., *Assistant Professor of Biochemistry*  
 Jonathan Peter Leis (1974), Ph.D., *Assistant Professor of Microbiology*  
 Warren Lerner (1961), Ph.D., *Professor of History*  
 Alan S. Levy (1973), Ph.D., *Assistant Professor of Psychology*  
 Harry L. Levy (1975), Ph.D., *Visiting Lecturer in Classical Studies*  
 Nelson Levy (1974), M.D., Ph.D., *Assistant Professor of Immunology*  
 Arie Y. Lewin (1974), Ph.D., *Professor of Business Administration*  
 H. Gregg Lewis (1975), Ph.D., *Professor of Economics*  
 Harold Walter Lewis (1946), Ph.D., *Professor of Physics*  
 Sara Lichtenstein (1974), Ph.D., *Assistant Professor of Art*  
 Melvyn Lieberman (1967), Ph.D., *Associate Professor of Physiology*  
 L. Sigfred Linderoth, Jr. (1965), M.E., *Professor of Mechanical Engineering and Materials Science*  
 Joseph Lipscomb, Jr. (1974), Ph.D., *Assistant Professor in Public Policy Sciences*  
 Paul William Lisowski (1974), Ph.D., *Assistant Professor of Physics*  
 Daniel A. Livingstone (1956), Ph.D., *Professor of Zoology*
- <sup>28</sup>Charles H. Lochmuller (1969), Ph.D., *Associate Professor of Chemistry*  
 Gregory Lockhead (1965), Ph.D., *Professor of Psychology*  
 Charles Houston Long (1974), Ph.D., *Professor of Religion*  
 William Longley (1968), Ph.D., *Associate Professor of Anatomy*  
 James S. Loos (1972), Ph.D., *Assistant Professor of Physics*  
 Donald Loveland (1973), Ph.D., *Professor of Computer Science*  
 John G. Lundberg (1970), Ph.D., *Associate Professor of Zoology*  
 William S. Lynn, Jr. (1954), M.D., *Associate Professor of Biochemistry*  
 George W. Lynts (1965), Ph.D., *Associate Professor of Geology*  
 John Nelson Macduff (1956), M.M.E., *Professor of Mechanical Engineering and Materials Science*
- <sup>29</sup>Barry MacKichan (1970), Ph.D., *Assistant Professor of Mathematics*  
 Kenneth S. McCarty (1959), Ph.D., *Professor of Biochemistry*  
 David R. McClay (1973), Ph.D., *Assistant Professor of Zoology*  
 John B. McConahay (1974), Ph.D., *Associate Professor of Psychology and Associate Professor of Policy Sciences*  
 Joe M. McCord (1970), Ph.D., *Associate in Biochemistry*  
 Barbara P. McCool (1975), Ph.D., *Associate Professor of Health Administration*  
 Ralph C. McCoy (1973), M.D., *Assistant Professor of Pathology*  
 James H. McElhaney (1973), Ph.D., *Professor of Biomedical Engineering*

<sup>24</sup>Sabbatical leave, academic year, 1975-76.

<sup>25</sup>Leave of absence, academic year 1975-76.

<sup>26</sup>Sabbatical leave, fall semester, 1975.

<sup>27</sup>Leave of absence, academic year, 1975-76.

<sup>28</sup>Leave of absence, academic year, 1975-76.

<sup>29</sup>Leave of absence, academic year, 1975-76.

- Marjorie McElroy (1970) Ph.D., Assistant Professor of Political Science  
 Margaret A. McKean (1974), Ph.D., Assistant Professor of Political Science  
 Patrick A. McKee (1969), M.D., Assistant Professor of Biochemistry
- <sup>30</sup>John C. McKinney (1957), Ph.D., Professor of Sociology  
 Thomas J. McManus (1961), M.D., Associate Professor of Physiology
- <sup>31</sup>Andrew T. McPhail (1968), Ph.D., Professor of Chemistry  
 George L. Maddox (1960), Ph.D., Professor of Sociology  
 Wesley A. Magat (1974), Ph.D., Assistant Professor of Business Administration  
 M. Stephen Mahaley (1965), M.D., Ph.D., Assistant Professor of Anatomy  
 Edward P. Mahoney (1965), Ph.D., Associate Professor of Philosophy  
 Steven F. Maier (1971), Ph.D., Assistant Professor of Business Administration  
 Lazaro J. Mandel (1972), Ph.D., Assistant Professor of Physiology  
 Peter N. Marinos (1968), Ph.D., Professor of Electrical Engineering and Professor of Computer Science  
 Sidney David Markman (1947), Ph.D., Professor of Art History and Archeology  
 Gail R. Marsh (1975), Ph.D., Lecturer in Psychology
- <sup>32</sup>David V. Martin (1962), Ed.D., Associate Professor of Education  
 Seymour Mauskopf (1964), Ph.D., Associate Professor of History  
 Robert Arthur Maxwell (1971), Ph.D., Professor of Pharmacology  
 George Mayer (1974), Ph.D., Adjunct Associate Professor of Mechanical Engineering and Materials Science  
 Elgin W. Mellow, Jr. (1965), Ph.D., Associate Professor of English  
 Lorne Mendell (1968), Ph.D., Associate Professor of Physiology  
 Daniel B. Menzel (1971), Ph.D., Associate Professor of Pharmacology  
 Louis John Metz (1970), Ph.D., Adjunct Associate Professor of Forest Soils  
 Richard S. Metzgar (1962), Ph.D., Professor of Immunology  
 Johannes Horst Max Meyer (1959), D.Sc., Professor of Physics
- <sup>33</sup>Eric M. Meyers (1969), Ph.D., Associate Professor of Religion
- <sup>34</sup>Martin Miller (1970), Ph.D., Associate Professor of History
- <sup>35</sup>Elliott Mills (1968), Ph.D., Associate Professor of Physiology  
 William Mishler (1972), Ph.D., Assistant Professor of Political Science  
 Thomas G. Mitchell (1974), Ph.D., Assistant Professor of Microbiology  
 Gerald Monsman (1965), Ph.D., Associate Professor of English  
 John W. Moore (1961), Ph.D., Professor of Physiology  
 Lawrence C. Moore, Jr. (1966), Ph.D., Associate Professor of Mathematics  
 Wayne J. Morse (1974), Ph.D., Associate Professor of Business Administration  
 Montrose J. Moses (1959), Ph.D., Professor of Anatomy
- <sup>36</sup>Earl George Mueller (1945), Ph.D., Professor of Art  
 Bruce J. Muga (1967), Ph.D., Professor of Civil Engineering  
 Roland E. Murphy (1967-68; 1971), S.T.D., Professor of Old Testament  
 Francis Joseph Murray (1960), Ph.D., Professor of Mathematics  
 George C. Myers (1968), Ph.D., Professor of Sociology  
 Donald H. Namm (1974), Ph.D., Assistant Professor of Pharmacology  
 Toshio Narahashi (1962-63; 1965), Ph.D., Professor of Pharmacology  
 Sydney Nathans (1966), Ph.D., Associate Professor of History  
 Aubrey Willard Naylor (1952), Ph.D., James B. Duke Professor of Botany  
 Thomas H. Naylor (1964), Ph.D., Professor of Economics and Professor of Computer Science  
 Robert H. Neilson (1975), Ph.D., Assistant Professor of Chemistry  
 Henry Winston Newson (1948), Ph.D., James B. Duke Professor of Physics  
 Francis Newton (1967), Ph.D., Professor of Latin in Classical Studies  
 Charles Adam Nichol (1971), Ph.D., Professor of Pharmacology  
 Jack L. Nichols (1970), Ph.D., Associate Professor of Microbiology  
 Robert Bruce Nicklas (1965), Ph.D., Professor of Zoology  
 Robert Niess (1971), Ph.D., Professor of Romance Languages  
 Loren W. Nolte (1966), Ph.D., Professor of Electrical Engineering and Professor of Biomedical Engineering  
 Thomas T. Norton (1972), Ph.D., Assistant Professor of Psychology and Assistant Professor of Physiology

<sup>30</sup>Sabbatical leave, fall semester, 1975.

<sup>31</sup>Sabbatical leave, spring semester, 1976.

<sup>32</sup>Sabbatical leave, fall semester, 1975.

<sup>33</sup>Sabbatical leave, academic year, 1975-76.

<sup>34</sup>Leave of absence, academic year, 1975-76.

<sup>35</sup>Sabbatical leave, July 1, 1975 through June 30, 1976.

<sup>36</sup>Sabbatical leave, fall semester, 1975.



- <sup>37</sup>Richey Novak (1969), Ph.D., *Associate Professor of Germanic Languages and Literature*  
 Yasuhiko Nozaki (1962), Ph.D., *Associate in Biochemistry*  
 Holger C. Nygard (1960), Ph.D., *Professor of English*  
 John F. Oates (1967), Ph.D., *Professor of Ancient History in Classical Studies*  
 Jean F. O'Barr (1970), Ph.D., *Lecturer in Political Science*
- <sup>38</sup>William O'Barr (1969), Ph.D., *Associate Professor of Anthropology*  
 Fearghus O'Foghlu (1975), Ph.D., *Adjunct Professor of Physics*  
 Ronald W. Oppenheim (1973), Ph.D., *Lecturer in Psychology*  
 Robert T. Osborn (1954), Ph.D., *Professor of Religion*  
 Suydam Osterhout (1959), M.D., Ph.D., *Professor of Microbiology*  
 Athos Ottolenghi (1959), M.D., *Professor of Physiology and Pharmacology*
- <sup>39</sup>Harry Ashton Owen, Jr. (1951), Ph.D., *Professor of Electrical Engineering*  
 George M. Padilla (1965), Ph.D., *Associate Professor of Physiology*  
 David L. Paletz (1967), Ph.D., *Associate Professor of Political Science*  
 Aubrey E. Palmer (1944), C.E., *Associate Professor of Civil Engineering*  
 Richard A. Palmer (1966), Ph.D., *Associate Professor of Chemistry*  
 Erdman B. Palmore (1967), Ph.D., *Professor of Sociology*  
 William E. Parham (1972), Ph.D., *R. J. Reynolds Industries Professor of Chemistry*  
 Harold Talbot Parker (1939), Ph.D., *Professor of History*  
 Harry B. Partin (1964), Ph.D., *Associate Professor of Religion*  
 Merrell Lee Patrick (1964), Ph.D., *Associate Professor of Computer Science*  
 William Bernard Peach (1951), Ph.D., *Professor of Philosophy*  
 George Wilbur Pearsall (1964), Sc.D., *Professor of Mechanical Engineering and Materials Science*  
 Talmage Lee Peele (1939), M.D., *Professor of Anatomy and Lecturer in Psychology*  
 Ronald D. Perkins (1968), Ph.D., *Professor of Geology*  
 David W. Peterson (1973), Ph.D., *Professor of Business Administration*  
 Olan Lee Petty (1952), Ph.D., *Professor of Education*  
 Leland R. Phelps (1961), Ph.D., *Professor of German*  
 Jane Philpott (1951), Ph.D., *Professor of Botany and Professor of Wood Anatomy*
- <sup>40</sup>Orrin Pilkey (1965), Ph.D., *Professor of Geology*  
 Theo Clyde Pilkington (1958), Ph.D., *Professor of Biomedical Engineering and Professor of Electrical Engineering*
- <sup>41</sup>Robert A. Pittillo, Jr. (1968), Ed.D., *Associate Professor of Education*  
 Jacques C. Poirier (1955), Ph.D., *Professor of Chemistry*  
 Ned Allen Porter (1969), Ph.D., *Associate Professor of Chemistry*  
 Alejandro Portes (1975), Ph.D., *Professor of Sociology*  
 Herbert S. Posner (1968), Ph.D., *Associate Professor of Pharmacology*  
 William H. Poteat (1960), Ph.D., *Professor of Religion and Comparative Studies*  
 Philip Pratt (1966), M.D., *Professor of Pathology*  
 Richard M. Pratt (1975), Ph.D., *Visiting Professor of Geology*  
 Richard Lionel Predmore (1950), D.M.L., *Professor of Romance Languages*  
 Jack J. Preiss (1959), Ph.D., *Professor of Sociology*  
 Richard A. Preston (1961), Ph.D., *William K. Boyd Professor of History*
- <sup>42</sup>David Eugene Price (1973), Ph.D., *Associate Professor of Political Science and Associate Professor of Policy Sciences*  
 James Ligon Price, Jr. (1952), Ph.D., *Professor of Religion*  
 Louis DuBose Quin (1956), Ph.D., *Professor of Chemistry*
- <sup>43</sup>Naomi Quinn (1972), Ph.D., *Assistant Professor of Anthropology*
- <sup>44</sup>Jill Raitt (1973), Ph.D., *Associate Professor of Historical Theology*  
 R. Rajagopal (1974), Ph.D., *Assistant Professor of Quantitative Science*  
 K. V. Rajagopalan (1966), Ph.D., *Professor of Biochemistry*  
 Charles William Ralston (1954), Ph.D., *Professor of Forest Soils*  
 Dietolf Ramm (1969), Ph.D., *Assistant Professor of Computer Science*  
 Fidel Ramon (1974), Ph.D., *Adjunct Assistant Professor of Physiology and Pharmacology*  
 Dale B. J. Randall (1957), Ph.D., *Professor of English*  
 Michael Charles Reed (1974), Ph.D., *Professor of Mathematics*  
 Michael Kay Reedy (1969), M.D., *Associate Professor of Anatomy*

<sup>37</sup>Leave of absence, academic year, 1975-76.

<sup>38</sup>Sabbatical leave, academic year, 1975-76.

<sup>39</sup>Sabbatical leave, academic year, 1975-76.

<sup>40</sup>Leave of absence, academic year, 1975-76.

<sup>41</sup>Sabbatical leave, fall semester, 1975.

<sup>42</sup>Sabbatical leave, fall semester, 1975.

<sup>43</sup>Leave of absence, academic year, 1975-76.

<sup>44</sup>Leave of absence, January 15, 1975 through December 15, 1975.

- Edmund Reiss (1967), Ph.D., *Professor of English*  
 Jacqueline A. Reynolds (1969), Ph.D., *Associate Professor of Biochemistry*  
 Willy E. Rice (1975), Ph.D., *Assistant Professor of Sociology*  
 David Claude Richardson (1969), Ph.D., *Associate Professor of Biochemistry*  
 Lawrence Richardson, Jr. (1966), Ph.D., *Professor of Latin in Classical Studies*  
<sup>45</sup>Kent J. Rigsby (1971), Harvard Society of Fellows, *Assistant Professor of Classics*  
 Nathan Russell Roberson (1963), Ph.D., *Professor of Physics*  
 George W. Roberts (1971), Ph.D., *Associate Professor of Philosophy*  
 Verne Louis Roberts (1973), Ph.D., *Adjunct Professor of Mechanical Engineering and Materials Science*  
 J. David Robertson (1966), M.D., Ph.D., *James B. Duke Professor of Anatomy*  
 Charles K. Robinson (1961), Ph.D., *Associate Professor of Philosophical Theology*  
 George Robinson (1971), Ph.D., *Assistant Professor of Psychology*  
 Hugh G. Robinson (1964), Ph.D., *Professor of Physics*  
 Herman R. Robl (1959-64; 1966), Ph.D., *Adjunct Professor of Physics*  
 Ronald L. Rogowski (1975), Ph.D., *Associate Professor of Political Science*  
 James L. Rolleston (1975), Ph.D., *Associate Professor of Germanic Languages and Literature*  
 Theodore Ropp (1938), Ph.D., *Professor of History*  
 Gerald Martin Rosen (1972), Ph.D., *Assistant Professor of Physiology and Pharmacology*  
 Lawrence Rosen (1974), Ph.D., *Associate Professor of Anthropology*  
 Myron Rosenthal (1969), Ph.D., *Assistant Professor of Physiology*  
 David J. Ross (1972), Ph.D., *Assistant Professor of Philosophy*  
 Wendell F. Rosse (1966), M.D., *Associate Professor of Immunology*  
 Susan Roth (1973), Ph.D., *Assistant Professor of Psychology*  
 Donald Francis Roy (1950), Ph.D., *Professor of Sociology*  
 Clyde de Loache Ryals (1973), Ph.D., *Professor of English*  
 Harvey J. Sage (1964), Ph.D., *Associate Professor of Biochemistry and Assistant Professor of Immunology*  
 Edward A. Saibel (1975), Ph.D., *Adjunct Professor in Civil Engineering*  
<sup>46</sup>Lester M. Salamon (1973), Ph.D., *Assistant Professor of Political Science and Assistant Professor of Policy Science*  
 John V. Salzano (1956), Ph.D., *Associate Professor of Physiology*  
 David H. Sanford (1970), Ph.D., *Associate Professor of Philosophy*  
 Joseph E. Sarneski (1975), Ph.D., *Visiting Assistant Professor of Chemistry*  
 Lloyd Saville (1946), Ph.D., *Professor of Economics*  
 Saul M. Schanberg (1967), M.D., Ph.D., *Professor of Pharmacology*  
 Harold Schiffman (1963), Ph.D., *Professor of Psychology*  
 Knut Schmidt-Nielsen (1952), Mag.Sc., Dr.Phil., *James B. Duke Professor of Comparative Physiology in the Department of Zoology*  
 David W. Schomberg (1968), Ph.D., *Assistant Professor of Physiology*  
 James M. Schooler, Jr. (1970), Ph.D., *Assistant Professor of Physiology*  
 Anne Firor Scott (1961), Ph.D., *Professor of History*  
<sup>47</sup>David W. Scott (1971), Ph.D., *Associate Professor of Immunology*  
 William E. Scott (1958), Ph.D., *Professor of History*  
 Richard A. Scoville (1961), Ph.D., *Associate Professor of Mathematics*  
 Richard B. Searles (1965), Ph.D., *Associate Professor of Botany*  
 Hillard Foster Seigler (1967), M.D., *Associate Professor of Immunology*  
 Edward J. Shaughnessy, Jr. (1975), Ph.D., *Assistant Professor of Mechanical Engineering*  
 Barbara R. Shaw (1975), Ph.D., *Assistant Professor of Chemistry*  
 John Shelburne (1973), M.D., Ph.D., *Assistant Professor of Pathology*  
 Marion L. Shepard (1967), Ph.D., *Associate Professor of Mechanical Engineering and Materials Science*  
 Joseph R. Shoenfield (1952), Ph.D., *Professor of Mathematics*  
<sup>48</sup>William Derek Shows (1967), Ph.D., *Lecturer in Psychology*  
 R. Baird Shuman (1962), Ph.D., *Professor of Education*  
 Lewis M. Siegel (1966), Ph.D., *Associate Professor of Biochemistry*  
 Ida Harper Simpson (1967), Ph.D., *Associate Professor of Sociology*  
 Theodore Alan Slotkin (1971), Ph.D., *Associate Professor of Physiology and Pharmacology*  
 Carol A. Smith (1974), Ph.D., *Associate Professor of Anthropology*  
 D. Moody Smith (1965), Ph.D., *Professor of New Testament Interpretation*  
<sup>49</sup>David A. Smith (1962), Ph.D., *Associate Professor of Mathematics*  
 Donald S. Smith, II (1959), M.H.A., *Assistant Professor of Health Administration*  
 Grover C. Smith (1952), Ph.D., *Professor of English*

<sup>45</sup>Sabbatical leave, spring semester, 1976.

<sup>46</sup>Leave of absence, fall semester, 1975.

<sup>47</sup>Sabbatical leave, academic year, 1975-76.

<sup>48</sup>Leave of absence, July 1, 1975 through June 30, 1976.

<sup>49</sup>Sabbatical leave, academic year, 1975-76.

- <sup>50</sup>Harmon L. Smith (1959), Ph.D., *Professor of Moral Theology*  
 Joel Smith (1958), Ph.D., *Professor of Sociology*  
 Peter Smith (1959), Ph.D., *Professor of Chemistry*  
 Ralph E. Smith (1970), Ph.D., *Associate Professor of Microbiology*  
 Robert Kent Smith (1975), Ph.D., *Assistant Professor of Physics*  
 Ralph A. Snyderman (1974), M.D., *Assistant Professor of Immunology*
- <sup>51</sup>George G. Somjen (1963), M.D., *Professor of Physiology and Lecturer in Psychology*  
 Joachim E. Sommer (1957), M.D., *Professor of Pathology*  
 Madison S. Spach (1964), M.D., *Associate Professor of Physiology*  
 Thomas Arthur Spragens, Jr. (1967), Ph.D., *Associate Professor of Political Science*  
 Carol B. Stack (1975), Ph.D., *Assistant Professor of Policy Sciences*  
 Olaf Stackelberg (1963), Ph.D., *Associate Professor of Mathematics*  
 John E. R. Staddon (1967), Ph.D., *Professor of Psychology*  
 William J. Stambaugh (1961), Ph.D., *Professor of Forest Pathology*  
 Dennis Keith Stanley (1961), Ph.D., *Associate Professor of Classical Studies*  
 Charles Franklin Starmer, Jr. (1966), Ph.D., *Associate Professor of Computer Science*  
 Howard Steinman (1970), Ph.D., *Associate in Biochemistry*  
 David Curtis Steinmetz (1971), Th.D., *Associate Professor of Church History and Doctrine*  
 Philip Stewart (1972), Ph.D., *Associate Professor of Romance Languages*  
 Alan A. Stone (1975), Ph.D., *Assistant Professor of History*  
 Deborah Stone (1974), Ph.D., *Lecturer in Public Policy Sciences*  
 Donald E. Stone (1963), Ph.D., *Professor of Botany*
- <sup>52</sup>Kenneth B. Storey (1974), Ph.D., *Assistant Professor of Zoology*
- <sup>53</sup>Boyd R. Strain (1969), Ph.D., *Associate Professor of Botany*  
 Victor H. Strandberg (1966), Ph.D., *Associate Professor of English*  
 Timothy Lee Strickler (1973), Ph.D., *Assistant Professor of Anatomy*  
 Howard Austin Strobel (1948), Ph.D., *Professor of Chemistry*  
 J. Bolling Sullivan (1970), Ph.D., *Assistant Professor of Biochemistry*  
 Elizabeth Read Sunderland (1939-42; 1943), Ph.D., *Professor of Art*
- <sup>54</sup>John P. Sutherland (1969), Ph.D., *Associate Professor of Zoology*
- <sup>55</sup>Charles Tanford (1959), Ph.D., *James B. Duke Professor of Biochemistry*  
 Robert Taylor (1974), Ph.D., *Assistant Professor of Business Administration*  
 John J. TePaske (1967), Ph.D., *Professor of History*  
 Marcel Tetel (1960), Ph.D., *Professor of Romance Languages*  
 Frederick L. Thurstone (1967), Ph.D., *Professor of Biomedical Engineering and Professor of Electrical Engineering*  
 Edward A. Tiryakian (1965), Ph.D., *Professor of Sociology*  
 Craig Tisher (1969), M.D., *Associate Professor of Pathology*  
 H. Dennis Tolley (1975), Ph.D., *Assistant Professor of Biostatistics and Assistant Professor of Biomedical Engineering*  
 Edward Tower (1974), Ph.D., *Associate Professor of Economics*  
 Vladimir G. Trembl (1967), Ph.D., *Professor of Economics*  
 Richard J. Trilling (1970), Ph.D., *Assistant Professor of Political Science*  
 Yuet Tsui (1975), Ph.D., *Assistant Professor of Civil Engineering*  
 Vance Tucker (1964), Ph.D., *Professor of Zoology*  
 Arlin Turner (1953), Ph.D., *James B. Duke Professor of English*  
 Richard L. Tuthill (1953), Ed.D., *Professor of Economic Geography*  
 Lee E. Tyrey (1974), Ph.D., *Assistant Professor of Anatomy*  
 Senol Utku (1970), Sc.D., *Professor of Civil Engineering*  
 Arturo Valenzuela (1970), Ph.D., *Assistant Professor of Political Science*  
 Thomas C. Vanaman (1970), Ph.D., *Associate Professor of Microbiology*  
 James H. Vander Weide (1972), Ph.D., *Assistant Professor of Business Administration*  
 John M. Vernon (1966), Ph.D., *Professor of Economics*  
 Aleksandar Sedmak Vesic (1964), D.Sc., *J. A. Jones Professor of Civil Engineering*  
 P. Aarne Vesilind (1970), Ph.D., *Associate Professor of Civil Engineering and Associate Professor of Environmental Studies*  
 Elia E. Villanueva (1961), M.A., *Associate Professor of Physical Therapy*  
 Patrick R. Vincent (1954), Ph.D., *Associate Professor of Romance Languages*  
 F. Stephen Vogel (1961), M.D., *Professor of Pathology*

<sup>50</sup>Sabbatical leave, spring semester, 1976.

<sup>51</sup>Sabbatical leave, fall semester, 1975.

<sup>52</sup>Leave of absence, academic year, 1975-76.

<sup>53</sup>Sabbatical leave, academic year, 1975-76.

<sup>54</sup>Sabbatical leave, January 15, 1976 through December 15, 1976.

<sup>55</sup>Sabbatical leave, fall semester, 1975.

- Steven Vogel (1966), Ph.D., Associate Professor of Zoology
- Olaf T. von Ramm (1974), Ph.D., Assistant Professor of Biomedical Engineering
- Fred M. Vukovich (1967), Ph.D., Adjunct Associate Professor of Forest Meteorology
- Howard C. Wachtel (1968), Ph.D., Associate Professor of Biomedical Engineering and Assistant Professor of Physiology
- Stephen A. Wainwright (1964), Ph.D., Associate Professor of Zoology
- Frances E. Walker (1971), Ph.D., Professor of Physics
- Andrew G. Wallace (1971), Ph.D., Assistant Professor of Physiology
- Thomas Dudley Wallace (1974), Ph.D., Professor of Economics
- Lise Wallach (1970), Ph.D., Lecturer in Psychology
- Michael Wallach (1962), Ph.D., Professor of Psychology
- Richard L. Walter (1962), Ph.D., Professor of Physics
- Paul P. Wang (1968), Ph.D., Professor of Electrical Engineering
- Calvin L. Ward (1952), Ph.D., Associate Professor of Zoology
- Frances Ellen Ward (1969), Ph.D., Associate Professor of Immunology
- Bruce W. Wardropper (1962), Ph.D., William Hanes Wannamaker Professor of Romance Languages
- Dennis B. Warner (1973), Ph.D., Adjunct Assistant Professor of Civil Engineering
- Seth L. Warner (1955), Ph.D., Professor of Mathematics
- David Grant Warren (1975), J.D., Professor of Health Administration
- Richard Lyness Watson, Jr. (1939), Ph.D., Professor of History
- Katherine Way (1968), Ph.D., Adjunct Professor of Physics
- Robert E. Webster (1970), Ph.D., Associate Professor of Biochemistry
- Eliot Roy Weintraub (1970), Ph.D., Associate Professor of Economics
- Morris Weisfeld (1967), Ph.D., Professor of Mathematics
- Henry Weitz (1950), Ed.D., Professor of Education
- Richard L. Wells (1962), Ph.D., Professor of Chemistry
- Paul Welsh (1948), Ph.D., Professor of Philosophy
- Robert W. Wheat (1956), Ph.D., Professor of Microbiology and Assistant Professor of Biochemistry
- Charles W. White (1970), Ph.D., Assistant Professor of Psychology
- Richard A. White (1963), Ph.D., Professor of Botany
- Henry M. Wilbur (1973), Ph.D., Assistant Professor of Zoology
- Karl Milton Wilbur (1946), Ph.D., James B. Duke Professor of Zoology
- Robert L. Wilbur (1957), Ph.D., Professor of Botany
- Pelham Wilder, Jr. (1949), Ph.D., Professor of Chemistry
- Hilda Pope Willett (1948), Ph.D., Professor of Microbiology
- George W. Williams (1957), Ph.D., Professor of English
- William Hailey Willis (1963), Ph.D., Professor of Greek in Classical Studies
- James F. Wilson (1967), Ph.D., Associate Professor of Civil Engineering
- John Wilson (1968), Ph.D., Associate Professor of Sociology
- <sup>56</sup>Thomas George Wilson (1959), Sc.D., Professor of Electrical Engineering
- Cliff W. Wing, Jr. (1965), Ph.D., Professor of Psychology
- <sup>57</sup>Orval S. Wintermute (1958), Ph.D., Associate Professor of Religion
- Ronald Witt (1971), Ph.D., Associate Professor of History
- Benjamin Wittels (1961), M.D., Professor of Pathology
- Myron L. Wolbarsht (1968), Ph.D., Adjunct Professor of Biomedical Engineering, Adjunct Associate Professor of Physiology, and Lecturer in Psychology
- Peter H. Wood (1975), Ph.D., Associate Professor of History
- Max A. Woodbury (1966), Ph.D., Professor of Computer Science
- Donald Wright (1967), Ph.D., Associate Professor of Mechanical Engineering and Materials Science
- James E. Wuenscher (1970), Ph.D., Assistant Professor of Forest Ecology
- Allen M. Wyse (1974), Ph.D., Assistant Professor of Economics
- David O. Yandle (1967), Ph.D., Associate Professor of Forest Mathematics
- William P. Yohe (1958), Ph.D., Professor of Economics
- Charles R. Young (1954), Ph.D., Professor of History
- Franklin W. Young (1944-50; 1968), Ph.D., Amos Ragan Kearns Professor of New Testament and Patristic Studies in Religion
- John G. Younger (1974), Ph.D., Assistant Professor of Classical Studies
- Julie H. Zalkind (1973), Ph.D., Assistant Professor of Business Administration
- Peter Zwadyk, Jr. (1971), Ph.D., Associate Professor of Pathology
- <sup>58</sup>Hans J. Zweerink (1970), Ph.D., Associate Professor of Microbiology

<sup>56</sup>Sabbatical leave, academic year, 1975-76.

<sup>57</sup>Sabbatical leave, spring semester, 1976.

<sup>58</sup>Sabbatical leave, July 1, 1976 through June 30, 1977.



## Emeritus Professors

Frances Dorothy Acomb (1945), Ph.D., *Professor Emeritus of History*  
M. Margaret Ball (1963), Ph.D., *Professor Emeritus of Political Science*  
Katherine May Banham (1946), Ph.D., *Professor Emeritus of Psychology*  
Joseph W. Beard (1937), M.D., *James B. Duke Professor Emeritus of Virology*  
Frederick Bernheim (1930), Ph.D., *James B. Duke Professor Emeritus of Pharmacology*  
Mary L. C. Bernheim (1930), Ph.D., *Professor Emeritus of Biochemistry*  
Edward Claude Bolmeier (1948), Ph.D., *Professor Emeritus of Education*  
Francis Ezra Bowman (1945), Ph.D., *Professor Emeritus of English*  
Benjamin Boyce (1950), Ph.D., *James B. Duke Professor Emeritus of English*  
Frances Campbell Brown (1931), Ph.D., *Professor Emeritus of Chemistry*  
Benjamin Guy Childs (1924), M.A., *Professor Emeritus of Education*  
Kenneth Willis Clark (1931), Ph.D., D.D., *Professor Emeritus of New Testament*  
Robert Taylor Cole (1935), Ph.D., *James B. Duke Research Professor Emeritus of Political Science*  
Norman Francis Conant (1935), Ph.D., *James B. Duke Professor Emeritus of Microbiology*  
Frederick A. G. Cowper (1918), Ph.D., *Professor Emeritus of Romance Languages*  
John S. Curtiss (1945), Ph.D., *James B. Duke Professor of History*  
Bingham Dai (1943), Ph.D., *Professor Emeritus of Psychology*  
Frank Traver de Vyver (1935), Ph.D., *Professor Emeritus of Economics*  
Neal Dow (1934), Ph.D., *Professor Emeritus of Romance Languages*  
Francis George Dressel (1929), Ph.D., *Professor Emeritus of Mathematics*  
George Sharp Eadie (1930), Ph.D., *Professor Emeritus of Physiology and Pharmacology*  
Howard Easley (1930), Ph.D., *Associate Professor Emeritus of Education*  
William Whitfield Elliott (1925), Ph.D., *Professor Emeritus of Mathematics*  
Allan H. Gilbert (1920), Ph.D., *Professor Emeritus of English*  
Clarence Gohdes (1930), Ph.D., *James B. Duke Professor Emeritus of English*  
Irving Emory Gray (1930), Ph.D., *Professor Emeritus of Zoology*  
Paul M. Gross (1919), Ph.D., *William Howell Pegram Professor Emeritus of Chemistry*  
Louise Hall (1931), Ph.D., *Professor Emeritus of Architecture*  
Frank A. Hanna (1948), Ph.D., *Professor Emeritus of Economics*  
Charles Cleveland Hatley (1917), Ph.D., *Professor Emeritus of Physics*  
William S. Heckscher (1966), Ph.D., *Benjamin N. Duke Professor Emeritus of Art*  
Jay Broadus Hubbell (1927), Ph.D., *Professor Emeritus of English*  
Wanda S. Hunter (1947), Ph.D., *Professor Emeritus of Zoology*  
William H. Irving (1936), B.A. (Oxon.), Ph.D., *Professor Emeritus of English*  
Brady Rimbey Jordan (1927), Ph.D., *Professor Emeritus of Romance Languages*  
Helen L. Kaiser (1943), R.P.T., *Professor Emeritus of Physical Therapy*  
Paul Jackson Kramer (1931), Ph.D., *James B. Duke Professor Emeritus of Botany*  
Wladyslaw W. Kulski (1963), Dr. Jur., *James B. Duke Professor Emeritus of Russian Affairs*  
Charles Earl Landon (1926), Ph.D., *Professor Emeritus of Economics*  
John Tate Lanning (1927), Ph.D., *James B. Duke Professor Emeritus of History*  
John L. Lievsay (1962), Ph.D., *James B. Duke Professor Emeritus of English*  
Alan Krebs Manchester (1929), Ph.D., *Professor Emeritus of History*  
Glenn Robert Negley (1946), Ph.D., *Professor Emeritus of Philosophy*  
Walter McKinley Nielsen (1925), Ph.D., *James B. Duke Professor Emeritus of Physics*  
James G. Osborne (1961), B.S., *Professor Emeritus of Forestry*  
Robert Leet Patterson (1945), Ph.D., *Professor Emeritus of Philosophy*  
Lewis Patton (1926), Ph.D., *Professor Emeritus of English*  
Michael I. Pavlov (1960), Ph.D., *Associate Professor Emeritus of Slavic Languages and Literature*  
Harold Sanford Perry (1932), Ph.D., *Professor Emeritus of Botany*  
Ray C. Petry (1937), Ph.D., LL.D., *James B. Duke Professor Emeritus of Church History*  
Robert Stanley Rankin (1927), Ph.D., *Professor Emeritus of Political Science*  
Mabel F. Rudisill (1948), Ph.D., *Professor Emeritus of Education*  
Herman Salinger (1955), Ph.D., *Professor Emeritus of Germanic Languages and Comparative Literature*  
Charles Richard Sanders (1937), Ph.D., *Professor Emeritus of English*  
William H. Simpson (1930), Ph.D., *Professor Emeritus of Political Science*  
David Tillerson Smith (1930), M.D., Litt.D., *James B. Duke Professor Emeritus of Microbiology*  
H. Shelton Smith (1931), Ph.D., *James B. Duke Professor Emeritus of Religion*  
Joseph John Spengler (1934), Ph.D., *James B. Duke Professor Emeritus of Economics*  
William Franklin Stinespring (1936), Ph.D., *Professor Emeritus of Old Testament and Semitics*  
W. A. Stumpf (1948), Ph.D., *Professor Emeritus of Education*  
Edgar Tristram Thompson (1935), Ph.D., *Professor Emeritus of Sociology*  
James Nardin Truesdale (1930), Ph.D., *Professor Emeritus of Greek*  
Warren Chase Vosburgh (1928), Ph.D., *Professor Emeritus of Chemistry*  
Bruce A. Wells (1964), M.S.E.E., *Associate Professor Emeritus of Electrical Engineering*  
Robert Hilliard Woody (1929), Ph.D., *Professor Emeritus of History*



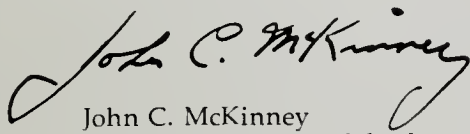
## To the Prospective Graduate Student at Duke University

Several years ago a committee of distinguished scholars was appointed and asked to appraise the state of graduate education at Duke University and indicate guidelines for its future development. I would like to quote briefly from the preamble of their report.

The primary role of a university is to provide a focus for the growth of ideas. Since ideas grow in the minds of men, communication between scholars, between faculty and students—in short, teaching—is the first basic function of a university. But without great ideas to communicate—ideas old and new, traditional and nascent—teaching is an exercise of futility. Therefore, the second basic function of a university must be research, characterized by the spirit of free inquiry and the exploration, analysis, and synthesis of ideas. These two faces of a university are complementary.

Even in the undergraduate college or in the professional school, the student learns best when moved by a spirit indistinguishable from the mood of the scholar engaged in original research. The ideas taught are, in fact, new to the student and therefore fit material for his "original" research. But it is in the graduate school that teaching and research become truly inseparable.

To the student in search of a superior graduate education Duke University has much to offer: excellent research facilities such as an outstanding library, a major computing center, modern laboratories—but above all, a highly productive graduate faculty dedicated to the twin functions of teaching and research. The following pages, and the information they contain, are addressed to the student seeking a soundly based graduate education.



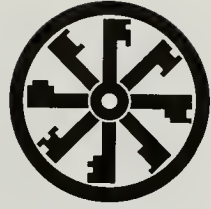
John C. McKinney  
*Dean of the Graduate School*





## Program Information





## Degrees Offered

The Graduate School of Duke University now offers the following degrees; Master of Arts (A.M.), Master of Science (M.S.), Master of Education (M.Ed.), Master of Arts in Teaching (M.A.T.), Master of Health Administration (M.H.A.), Doctor of Philosophy (Ph.D.), and Doctor of Education (Ed.D.).

## The Master's Degrees

To be considered as a candidate for a master's degree (A.M., M.S., M.Ed., M.A.T., M.H.A.), the graduate student must (1) have made passing grades in the first 12 units of course work, (2) have made a grade of *C* or *E* on at least 3 units of this work, and (3) have received the approval of the major department (or, in the case of the M.A.T. degree, of the supervisory committee).

**Residence Requirements.** Candidates for all master's degrees must spend, as a *minimum*, one full academic year (two successive semesters), or its equivalent in summer session terms, in residence at Duke University. Candidates who wish to complete their degrees wholly in the summer session must be in residence for a minimum of five summer terms. Additional time is frequently necessary. Three terms are held each summer. (See section on Residence under Academic Regulations.)

**Transfer of Graduate Credits.** A maximum of 6 units of graduate credit may be transferred for graduate courses completed at other institutions. Such units will be transferred only if the student has received a grade of *B* (or its equivalent) or better. *In any case, the transfer of graduate credit does not reduce the required minimum registration for a master's degree at Duke.* A student who wishes to transfer up to 6 units into his program must register at Duke for units equivalent to the number he is transferring. Request for transfer should be submitted on the approved graduate school form (T1).

A student who is granted such transfer credit may be permitted to register for as much as 12 units of thesis research instead of the usual 6 units. As another option, he may take as many as 6 units of further undergraduate training or 6 units of required language courses on the undergraduate level. In no case will credit be allowed for extension or correspondence courses.

Credit for graduate courses taken at Duke by a student (not undergraduate) before his admission to the Graduate School or while registered as a nondegree

student may be carried over into a graduate degree program if (1) the action is recommended by the director of graduate studies of the department and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

**Time Limits for Completion of Master's Degrees.** The master's degree candidate who is in residence for consecutive academic years should complete all requirements for the degree *within two calendar years* from the date of his first registration in the Graduate School. Any candidate must complete all requirements *within six calendar years of his first registration*.

To be awarded a degree in May, the student must have completed all requirements, including the recording of transfer credit, by the last day of the final examination period. If a thesis is one of the requirements, it must be submitted to the Graduate School Office no later than April 15. Candidates desiring to have their degrees conferred on September 1 must have completed all requirements, including the recording of transfer of credit, by the final day of the Duke University summer session. A candidate completing degree requirements after that date will have his degree conferred at the following May Graduation Exercises.

**The Thesis.** The thesis should demonstrate the student's ability to collect, arrange, interpret, and report pertinent material on a research problem. Although a publishable document is not required, the thesis must be written in an acceptable style and should exhibit the student's competence in scholarly procedures. Requirements of form are set forth in the *Duke University Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School Office.

**Recommendation for Teacher Certification.** An elementary school teacher who already holds a certificate and who desires the recommendation of Duke University for a graduate teaching certificate must include in his program a minimum of 12 units in subjects ordinarily taught in elementary school and 12 units of education courses appropriate to his professional development. A secondary school teacher must include in his program a minimum of 18 units in his teaching field and 6 units in courses of education appropriate to his professional development.

## MASTER OF ARTS

The Master of Arts degree may be earned either with or without presentation of a thesis. Certain general requirements must be met, however, whether or not the thesis is written.

**Prerequisites.** As prerequisites to graduate study in his major subject, the student must have completed a minimum of 24 semester hours—ordinarily 12 semester hours of approved college courses in that subject and 12 additional semester hours in that subject or in related work. Since some departments require more than 12 semester hours in the proposed field of study, the student should read carefully the special requirements listed by his major department, described in the departmental course section in this *Bulletin*. If special master's degree requirements are not specified in this section, a prospective student should write directly to the appropriate director of graduate studies.

**Language Requirements.** The Graduate School requires no foreign language for the master's degree. Certain departments, however, do have a foreign language requirement for their master's programs. Any such requirement must be satisfied before the master's examination is taken. (See the departmental sections in the chapter on Courses of Instruction and the chapter on Registration and Regulations.)



**Major and Related Subjects.** The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in the major subject. A minimum of 6 units must be in a minor subject or related fields which are approved by the student's major department. The remaining 6 units of the required 24 may be taken in either the major or in related fields approved by the major department and by the Dean of the Graduate School. A maximum of 6 units may be earned either by submission of an approved thesis, or by completing courses or other academic activities approved by the student's department. (See below.) Thirty units of graduate credit at Duke constitutes minimum enrollment for the Master of Arts degree.

**Completing the Program with Thesis.** All basic requirements for preparing the thesis are described in the *Guide for the Preparation of Theses and Dissertations*, available in the Graduate School Office.

Four typewritten copies of the thesis bound in snap binders which may be secured through the Graduate School Office must be submitted in an approved form to the Dean of the Graduate School on or before April 15 for a May degree, or one week before the final day of the Duke University third summer session for a September degree, and at least one week before the scheduled date of the final examination. The copies will then be distributed by the student to the several members of the examining committee. Two copies for the Library and one copy for the adviser will be bound upon payment of \$5.50 per volume. Additional copies may be bound at the \$5.50 per volume rate.

**Completing the Program without Thesis.** Individual departments decide the options with which a Master of Arts degree may be completed without presentation of a thesis. The student's committee usually outlines the requirements for a degree program after the student has completed at least 9 units of graded course work. Beyond the 24 units required in major or related course work, 6 units may be earned either through course work or through other academic activities approved by the student's department and committee. Such academic exercises might include an additional 3 units of graded course work complemented, for





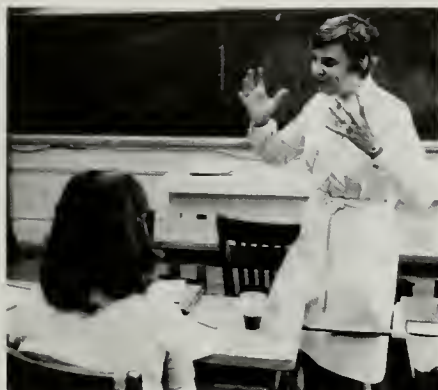
example, by the following: (1) passing an oral examination on a three- to five-page research prospectus, plus a substantial bibliography on a topic within the student's major field, or (2) submission to the committee of two carefully revised term papers, preferably written originally for different instructors and originally earning a grade of C or higher. In any case, the student's total minimum registration will be for 30 units of graduate credit followed by a final examination. (See below).

**The Examining Committee and the Examination.** The faculty member who directs the student's program recommends an examining committee composed of himself and two other members of the graduate faculty, one of whom usually must be from a department other than the major department. If the student has been permitted to take related work within the major department, the third member may be chosen from within the department. Nominations for membership on this committee are submitted for approval to the Dean of the Graduate School at least one week preceding the final examination.

The student's committee will conduct the examination and certify his success or failure by signing the card provided by the Graduate School Office. This card indicates completion of all requirements for the degree. If a thesis is presented, the committee also signs all copies of the thesis, and the candidate then returns the original, the first two copies, and any other copies he wished bound to the Graduate School Office.

**Filing the Intention to Graduate.** On or before *February 1* for a *May* degree or on or before *August 1* for a *September* degree, and at least one month prior to his final examination, the student must file in the Office of the Graduate School, on the official form, a declaration of intention to graduate. The declaration of





intention presents the title of the thesis or specifies the alternative academic exercises on which the degree candidate will be examined. The declaration must have the approval of both the director of graduate studies in the major department and the chairman of the student's advisory committee.

## MASTER OF SCIENCE

The degree of Master of Science is offered in various areas, including the following: botany, forestry, geology, pathology, physical therapy, statistics and computing, and four fields of engineering—biomedical, civil, electrical, and mechanical.

**Prerequisites.** A bachelor's degree is a prerequisite for the M.S. degree. Departments offering an M.S. degree consider for admission students from allied fields provided they have satisfactory scientific and mathematical backgrounds.

**Language Requirement.** There is no foreign language requirement in Master of Science degree programs.

**Other Degree Requirements.** Specific requirements vary according to the department. Please consult the section on Courses of Instruction for departmental information concerning prerequisites, minimum units required, and major and related work.

**Thesis and Examination.** Some departments require a thesis; all departments require an examination. The regulations and options for theses and other means of completing the program, as well as the provisions for examination and examining committee, are the same as the requirements for the Master of Arts degree discussed in the previous section.

## MASTER OF EDUCATION

**Prerequisites.** The M.Ed. degree is designed for persons intending to pursue a career in professional education. No specific undergraduate major is required for acceptance into a graduate program leading to this degree but the student must have earned a bachelor's degree and pursued an undergraduate program related to his professional goals.

Before the degree is conferred, the student must have completed one year of experience in professional education or have included in his program 6 units of practicum, internship, and/or field experience, or have met certification requirements by supervised student teaching in an accredited school.

**Major and Related Subjects.** The student must present acceptable grades for a minimum of 24 units of graduate courses. Of these, at least 12 units must be in a departmental major (administration, supervision, counseling, elementary education, secondary education, higher education, reading, teaching the emotionally disturbed, or other approved programs offered by the department). A minimum of 6 units must be in a minor subject or related areas within the Department of Education. The remaining 6 units of the required 24 may be taken in either the major or in related subjects. The nature of the additional 6 units for which the student must register depends on whether he is enrolled in a thesis or non-thesis program; i.e., the additional 6 units may be earned either by submitting an acceptable thesis or by completing courses in major and related subjects. A minimum of 30 units of earned credit is required for the degree.

**Completing the Program with Thesis.** The regulations governing the thesis are the same as those for the A.M. degree.

**Completing the Program without Thesis.** No sooner than the end of the term in which the student completed his course work, he must pass a comprehensive examination on his departmental major. The examination shall be prepared and conducted by members of the faculty as designated by the Director of Graduate Studies of the Department of Education.

## MASTER OF ARTS IN TEACHING

**Prerequisites.** The M.A.T. degree is designed for teachers already in service and for recent graduates of liberal arts colleges who wish to teach in a public school, private school, or junior college.

A student ordinarily should have completed a minimum of 12 semester hours in his proposed major subject and an additional 12 semester hours in related subjects. Should a student wish to undertake a graduate major different from his undergraduate major, the prerequisites may be modified upon the recommendation of the student's committee and the approval of the Dean of the Graduate School.

**Degree Programs.** Either of two programs may be arranged in consultation with the student's committee.

1. For students seeking certification: a major of 18 to 24 units in education and 12 to 18 units in non-education courses, a total of 36 units. A maximum of 6 units of the 36 units required under this option may be 100-level or undergraduate education courses. A grade of B or better must be earned in any undergraduate course included in the 36 unit requirement.

2. For students already certified: a major in non-education courses of 18 to 24 units and 6 to 12 units in education, a total of 30 units.

The non-education courses are to be taken in one or more subjects usually taught in the secondary schools. The quantity and departmental distribution of

this work will be determined by the needs of the individual student. A combined major in biological sciences or in physical sciences is possible in this program. Teachers who have already completed certification requirements must major in a teaching field in their Master of Arts in Teaching program. Students who have not completed certification requirements must major in education.

The Master of Arts in Teaching degree may be earned with or without the presentation of a thesis. If a student, in consultation with his committee, elects to present a thesis, 6 units of the total of 30 or 36 units required may be granted for thesis research. The regulations governing the thesis are the same as those for the A.M. degree *with thesis*.

**The Committee.** Each candidate for the degree will be assigned a committee, appointed by the director of graduate studies in the major department or area. This committee will consist of three members, at least one of whom will be from the Department of Education, and at least one from another department. Usually the chairman of the committee will be chosen from the department of the major.

## MASTER OF HEALTH ADMINISTRATION

The Department of Health Administration offers a curriculum for graduate students interested in the field of health services management. It is designed primarily for students who hope to assume major leadership roles in a variety of organizations and programs that involve the provision of health services in public or private settings.

The Master of Health Administration program is designed around a core of courses in health services and management sciences, with electives in behavioral sciences. The student selects one of four concentrations for in-depth study: finance, personnel, planning, or information management. The academic program is five semesters in length. Upon completing the degree, the student usually undertakes a 12-month rotating residency during which he receives a salary. (Students with prior experience may petition for a waiver of the residency.)

Students with any undergraduate major may apply. One year of calculus at the college level is the only prerequisite, and a special course is available each summer for students whose preparation in mathematics is inadequate or out of date.

## The Doctoral Degrees

**Transfer of Credit.** Up to 30 units of graduate credit in which a grade of G (or its equivalent) or better was earned may be accepted by transfer only after the student has earned at least 12 units of graduate credit at Duke. Such transfer credit must be on the recommendation of the chairman of the student's advisory committee and the director of graduate studies of the student's major department. (Graduate School form T1 should be used to request transfer of credit.)

Credit for graduate courses taken at Duke by a student (not undergraduate) before his admission to the Graduate School or while registered as a nondegree student may be carried over into a graduate degree program if: (1) the action is recommended by the student's director of graduate studies and approved by the Dean, (2) the work is not more than two years old, (3) the amount of such credit does not exceed 6 units, and (4) the work is of G level or better.

## DOCTOR OF PHILOSOPHY

The Ph.D. degree is a research degree. Although course work is a necessary part of the student's program, the mere accumulation of course credits will not





be sufficient for attaining this degree. The granting of the Ph.D. degree is based primarily upon the student's knowledge of a specialized field of study and upon the production of an acceptable dissertation embodying the results of original research.

**Requirements.** The formal requirements for the Ph.D. degree are as follows: (1) major and related courses, (2) foreign language(s) in most departments, (3) a supervisory committee for program of study, (4) residence, (5) preliminary examination, (6) dissertation, and (7) final examination. In order to be considered for candidacy for the Ph.D. degree, the student must have passing grades in all course work and a grade of C or better on at least 9 units of this course work.

**Foreign Languages.** The language requirements for the Doctor of Philosophy degree vary among departments. Some departments do not require a language; some require two languages; and others require a specific language. A prospective student should request information from the appropriate director of graduate studies if no such requirement is described under the departmental heading in this *Bulletin*. (For methods of meeting the requirement, see Language Requirements.)

A student working toward the doctoral degree should complete any language requirement set by his department by the end of his first year of residence. If he fails to meet the requirement by the end of his third semester of residence, he should register in the appropriate special reading course or courses. Any foreign language requirement must be met before the preliminary examination is taken.



**Major and Related Work.** The student's program of study demands substantial concentration on courses in his major department. However, a minimum of 6 units in a related field approved by his major department must be included. A few programs have been authorized by the Executive Committee of the Graduate Faculty to utilize courses in fields within the major department in fulfilling the related field requirement.

**Committee to Supervise the Program of Study.** As early in a student's course of study as is practicable and *not later than two months before the preliminary examination* the director of graduate studies in the major department will nominate for the approval of the Dean a supervising committee consisting of five members with one member designated as chairman. This committee will include at least three graduate faculty members of the major department and, usually, at least one from outside the department. For programs in which approval has been granted for related work from a clearly differentiated division within the department, one member of the committee will be chosen from that division. In this circumstance all members of the supervisory committee will be from the same department. This committee, with all members participating, will determine a program of study and administer the preliminary examination. Successful completion of the final examination requires four affirmative votes. The final examination may be administered by four members, if the representative of the related field is present.

**Residence.** The *minimum* registration requirement is 60 units of graduate credit, of which not more than 30 units may be accepted by transfer. Since a full program is 30 units per academic year, the prospective Ph.D. candidate who enters with the A.B. or B.S. degree must plan to spend in residence a *minimum* of two academic years; if he enters with the A.M. degree, his *minimum* residence is one academic year. (For the definition of *residence*, see the chapter on Academic Regulations.) Each student must register for a full program until he passes the preliminary examination. If there are undergraduate deficiencies in his program, he may be required to take preliminary undergraduate courses for which he will not receive degree credit. Even if there are no such undergraduate deficiencies, the student's supervisory committee will determine what requirements above the minimum, if any, the student must meet.

**Credit for Summer Work.** Credit earned in the summer session will not reduce the minimum required residence. (See the chapter on the Summer Session.)

**Time Limitations.** Courses, language certifications, or other credits for advanced standing which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted toward fulfilling the minimum requirements of the doctoral degree.

Ordinarily the student should pass the preliminary examination by the end of the third year of graduate study. If he has not passed the examination by the end of the third year of full-time registration, he must file with the Dean of the Graduate School a statement, approved by the director of graduate studies in his major department, explaining the delay and setting a date for the examination. Except under unusual circumstances, extension will not be granted beyond the middle of the fourth year.

The doctoral dissertation should be submitted and accepted within two calendar years after the preliminary examination is passed. Should the dissertation not be submitted and accepted within four years after the examination, the candidate, with the approval of his committee, may petition the Dean of the Graduate School for an extension of up to one year. If this extension is granted and the dissertation is not submitted and accepted by the new deadline, the stu-

dent must pass a second preliminary examination to remain a candidate for the degree. In such a case, the time limit for submitting the dissertation will be determined by the Dean of the Graduate School and the candidate's committee.

In cases of particular merit, and with the approval of the Dean of the Graduate School, departments may extend the limits of the total elapsed time within which credit will be allowed for courses, the language examination, and the preliminary examination. The graduate faculty of the departments will have these limits in mind when a student is considered for admission or readmission to the Ph.D. program, for approval to take the preliminary examination, and for approval to submit the dissertation and take the final examination. In instances of excessive elapsed time, revalidation of credits may be required. Responsibility for requiring such revalidation lies with the department. Proposed requirements for revalidation require the approval of the Dean of the Graduate School.

**Preliminary Examination.** A student is not accepted as a candidate for the Ph.D. degree until he has passed his preliminary examination at Duke. The examination ordinarily covers both the major field and related work. In the summer a preliminary examination may be scheduled only between the opening and closing dates of the summer session.

*Privilege of Reexamination.* Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all committee members. Failure on the second examination will render the student ineligible to continue his program for the Ph.D. degree at Duke University.

*Reduction in Registration.* The student who passes the preliminary examination during the first five weeks of each semester is eligible for a reduction in required registration. He should arrange with the Graduate School Office the change in registration he desires.

**The Dissertation.** The dissertation is expected to be a mature and competent piece of writing, embodying the results of significant and original research.

One month before the dissertation is presented and no later than *February 1* preceding the May commencement at which the degree is expected to be conferred, the student must file with the Dean of the Graduate School, on the official form available at the Graduate School Office, the title of the dissertation. This title must receive the written approval of both the director of graduate studies of the student's major department and the professor who directs the dissertation.

The basic requirements for preparing the dissertation (type of paper, form and binding) are prescribed in the *Guide for the Preparation of Theses and Dissertations*, copies of which are available in the Graduate School Office.

The dissertation must be completed to the satisfaction of the professor who directs it. Four typewritten copies bound in snap binders which may be secured through the Graduate School Office must be deposited with the Dean of the Graduate School on or before *April 1* preceding the May commencement at which the degree is to be conferred. The dissertation must be submitted to the Graduate School Office at least seven days before the scheduled date of the student's examination.

All doctoral dissertations are published on microfilm through University Microfilms, Ann Arbor, Michigan. Authors may copyright them, if they wish. Abstracts are published in *Dissertation Abstracts International*.

In brief, all copies of the dissertation, the original in clean type, will remain in snap binders until after the final examination. Three extra copies of the ab-



stract (not more than 600 words long) are submitted when the dissertation is first presented to the Graduate School Office. A nonreturnable fee of \$30.00 is charged for microfilming. If copyright is desired, an additional fee of \$15.00 is charged. The original and two copies will be bound at a cost of \$5.50 per volume. The student may request that more than three copies be so bound. A deposit of \$3.50 is collected for each snap binder on loan from the library for dissertation copies that will not be bound.

**Final Examination.** The final oral examination shall be primarily on the dissertation. However, questions may be asked in the candidate's major field. Except in unusual circumstances, approved by the Dean, a final examination will not be scheduled when school is not in session.

If a student fails his final examination, he may be allowed to take it a second time, but no sooner than six months from the date of his first examination. Permission to take the second examination must be obtained from the professor who directed the dissertation and from the Dean of the Graduate School. Failure to pass the second examination renders the student ineligible to continue work for the Ph.D. degree at Duke University.

**Deposit of the Dissertation.** After passing the examination, the candidate brings to the Graduate School Office the original and the first two copies of the dissertation, properly signed, as well as other copies he wishes bound. At this time he signs the microfilming agreement and pays microfilming and copyright fees.



## DOCTOR OF EDUCATION

The Ed.D. degree is a professional degree for those who are, or intended to become, high level professional personnel in the field of education. The student will choose one of the following as his area of concentration: (a) administration, (b) supervision, (c) counseling, (d) curriculum and instruction, (e) education of emotionally disturbed, (f) higher education, (g) reading, or (h) school psychology.

To be considered as a candidate for the Ed.D. degree, the student must have earned passing grades in the first 30 units of course work and a grade of C or better on 24 units of this course work.

**Major and Related Work.** The minimum registration requirement is 60 units of graduate credit, of which not more than 18 units may be in research or accepted by transfer. (Transfer credits which are more than six calendar years old at the time that the preliminary examination is passed will not be accepted.) The student's program must include at least 30 units of course work in his area of concentration and 12 units in related areas.

**Registration.** Candidates for the Ed.D. degree must have continuous registration and be registered for a minimum of 6 units of graduate credit in each academic year beginning with the first registration after admission to the Ed.D. degree. For purposes of the Ed.D. program, an academic year begins September 1 and continues through the following August 31.

Once the preliminary examination is passed, two alternatives are open to the student:

1. If the student remains in residence on campus during the fall and spring semesters, he must register for a minimum of 3 units of graduate credit or residence each semester. This registration entitles the student to all normal student benefits.

2. If the student goes out of residence (away from the University), he must register for at least 6 units of graduate credit during each academic year (September 1 through August 31) until all requirements for the degree have been met. This entitles the student to routine faculty consultation and use of facilities. The out-of-residence "Ed.D. Leave" registration is restricted only to those students who have not passed the preliminary examination for the Ed.D. degree.

**Committee to Supervise the Program of Study.** As early in a student's course of study as is practicable, and not later than two months before the preliminary examination, the Director of Graduate Studies will nominate for the approval of the Dean a supervising committee of five graduate faculty members, with one member designated as chairman. One or more members must represent the student's minor field. The committee will determine a program of study, administer the preliminary examination, and, with such changes as are approved by the Dean, administer the final doctoral examination.

**Experience.** Prior to receiving the Ed.D. degree, the student must have at least two years of experience in professional education.

The program of study must include a minimum of 6 units in practicum, internship, and/or field experience under the direction of one or more faculty members.

**Time Limitations.** The student ordinarily should pass the preliminary examination by the end of his sixth year of graduate study at Duke. If he has not passed it by this time, he must file a statement endorsed by the Director of Graduate Studies with the Dean of the Graduate School explaining the delay and setting a date for the examination.



**Preliminary Examination.** A student is not accepted as a candidate for the Ed.D. degree until he has passed the preliminary examination. The examination covers both the major field and related work and is taken during or shortly after the term in which the approved program of course work is completed.

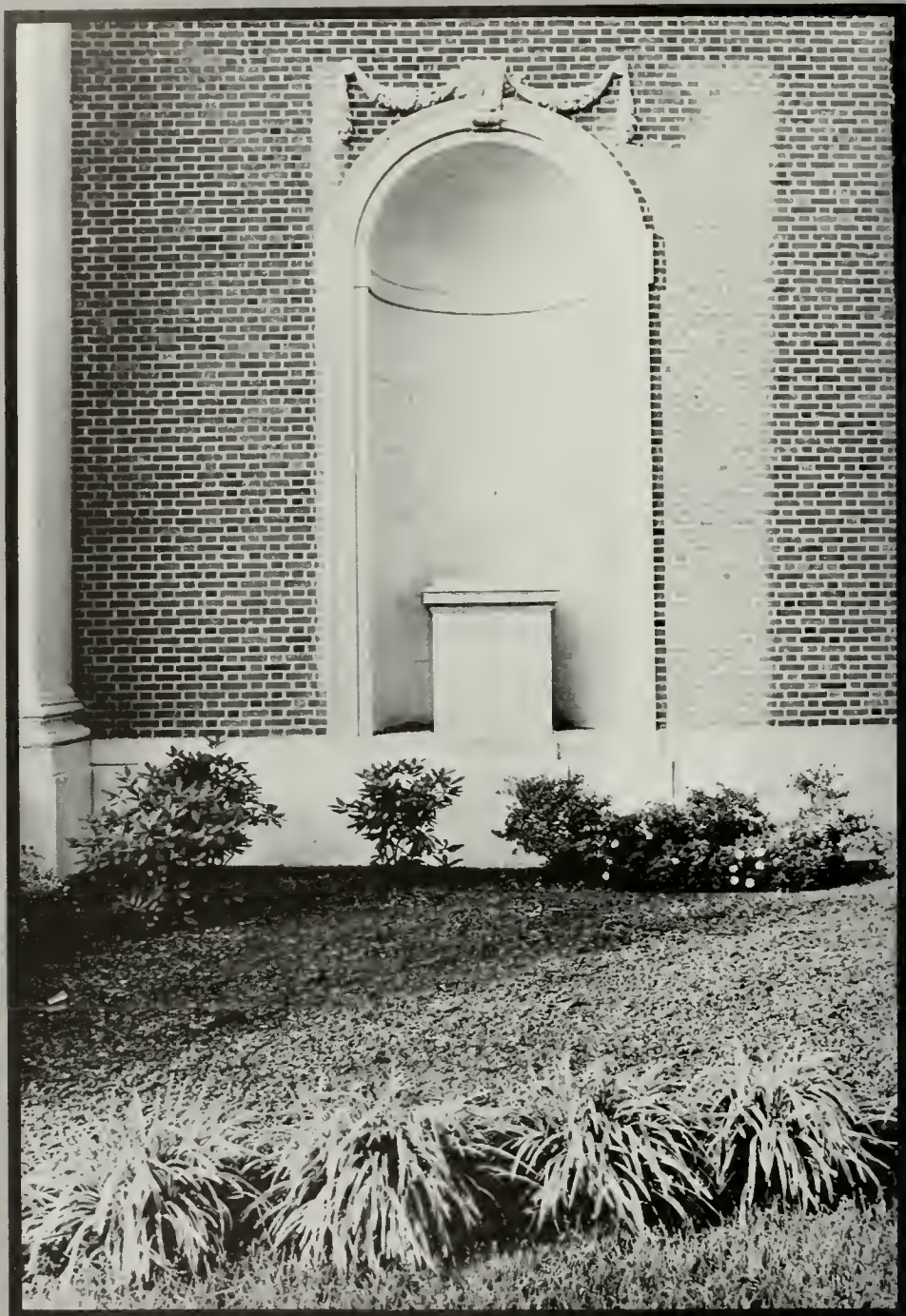
Should the student fail the preliminary examination, he may apply, with the consent of his supervisory committee and the Dean of the Graduate School, for the privilege of a second examination to be taken no sooner than three months after the date of the first. Successful completion of the second examination requires the affirmative vote of all members of the committee. Failure on the second examination will render the student ineligible to continue his program in the Department of Education at Duke University.

**Dissertation.** The dissertation is expected to be a mature and competent piece of writing which demonstrates the student's ability to collect, arrange, analyze, evaluate, interpret, and report pertinent material in his area of concentration. This may embody the results of applied research in the form of a major project or model (for example: in-service education plans for a school system, computer programs, curriculum guides, instructional materials) or the results of significant and original research.

Procedural regulations governing the Ed.D. dissertation and final examination are identical to those for the Ph.D. degree.

### **Policy of Nondiscrimination**

Duke University does not discriminate on the basis of race, color, national and ethnic origin, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other university program or activity. It admits qualified students of any race, color, national and ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.



## Special and Cooperative Programs



## Center for the Study of Aging and Human Development

The primary aims of the center have been to encourage and support fundamental and applied research concerned with the processes and health problems of adulthood and late life, to train investigators for research on aging, and to develop sources of scientific knowledge in the field of aging for governmental agencies as well as for private groups and individuals.

The center conducts a multidisciplinary two-year program for predoctoral or postdoctoral fellows interested in research training in some aspect of the behavioral sciences and psychophysiology in aging and adult development. Through faculty seminars and independent work, fellows are able to select and concentrate on various aspects of the human life cycle. Methods, specialized skills, and individual research are stressed. Resources of this all-University program located in the Medical Center include on-going longitudinal studies and a variety of biomedical, psychophysiological, and psychological laboratories and social scientific research programs. Access to the faculties of medicine and of arts and sciences is facilitated by a tradition of multidisciplinary research and a central location. Inquiries should be addressed to the Training Director, Center for the Study of Aging and Human Development, Duke University Medical Center, Durham, North Carolina 27710.

## Canadian Studies Program

The Canadian Studies Program was inaugurated in September, 1973, with the aid of grants from the William H. Donner Foundation and the Office of Education of the United States Department of Health, Education and Welfare for the purpose of formalizing and expanding the Duke Graduate School's interest in Canada, of introducing the study of Canadian life and culture at the undergraduate level, and of encouraging such study in primary and secondary schools. The program's basic aim is to increase American knowledge and understanding of Canada.

The program awards graduate fellowships for the study of Canada by American residents in the Departments of History, Political Science, Sociology, and Economics. Grants of travel aid for field research in Canada are also offered, and some teaching assistantships are given.

The program also sponsors lectures by Canadian specialists and cooper-



ates with the Center for Commonwealth Studies in sponsoring the Commonwealth joint seminar on Canadian topics.

Publications arising from research on Canada may be published in the Commonwealth Studies Series.

Inquiries should be addressed to the Director of Canadian Studies, Center for International Studies, 2101 Campus Drive, Duke University, Durham, North Carolina 27706.

## **Center for Commonwealth Studies**

The Center for Commonwealth Studies was established at Duke University in 1955 and has received financial support from the Carnegie Corporation of New York, the Rockefeller Foundation, and the Ford Foundation.

The principal purpose of the center is to initiate, stimulate, and further academic interest in the Commonwealth in the broad sense of the internal and domestic affairs of the countries which are at present or have been in the past, members of the Commonwealth in both contemporary and historical perspectives, and intra-Commonwealth relations of these countries. In addition, it is concerned with the organization of the Commonwealth and in promoting comparative studies in which the Commonwealth or Commonwealth nations play a prominent role.

The center awards fellowships to graduate students from Australia, Canada, and New Zealand who propose to study toward the Ph.D. degree in economics, history, or political science at Duke University. National selection committees in each of these countries facilitate the selection of fellows.

Each spring the center sponsors a joint seminar for graduate students in economics, history, law, and political science. The objective of this seminar is to encourage a broad approach to developments within the Commonwealth. The center also sponsors lectures at the University by distinguished Commonwealth scholars.

Studies resulting from research sponsored by the center are frequently published by the Duke University Press in the Commonwealth Studies Series, now numbering forty-two volumes. Inquiries should be addressed to the Director, Center for Commonwealth Studies, Duke University, Durham, North Carolina 27706.

## **Program in Comparative Studies on Southern Asia**

The Program in Comparative Studies on Southern Asia was established at Duke University in 1961, and has received fellowship and other support from the United States Office of Education for South Asian Studies from 1963 forward under the provisions of Title VI of the National Defense Act. The basic purpose of this program is twofold: to facilitate research on the political, historical, economic, and sociocultural development of Commonwealth countries in Southern Asia (India, Pakistan, Sri Lanka, Malaysia, and Singapore), and to provide for the systematic training of graduate students in anthropology, economics, education, history, political science, religion, and sociology, with special emphasis on the area.

The graduate student, in addition to meeting the requirements of the department in which he is enrolled, is expected to take Hindi-Urdu or another major South Asian language, related courses in other departments, and to undertake field research in the preparation of his dissertation.

Predocctoral fellowships under the conditions specified above are made under the NDEA Title VI language fellowships offered by the United States



Office of Education. Departmental and other University grants are open to applications.

Facilitation and support of research activities by members of the Duke University faculty and graduate students are important aspects of the program's activities. Research grants for faculty and students are also available from the American Institute of Indian Studies. Research facilities include those materials received as a result of the University's participation in a library acquisitions program under the terms of Public Law 480.

The program has undertaken the publication of three series: hardcover monographs, reprints of articles of note dealing with the Southern Asian region, and a series of occasional papers. It also brings visiting Asian scholars to the campus for lectures and symposia, and co-sponsors forums and research activities with the Carolina Population Center of the University of North Carolina, the Southern Atlantic States Association for Asian and African Studies, and the Association of Asian Studies.

Inquiries should be addressed to the Administrative Assistant, Program in Comparative Studies on Southern Asia, Duke University, Durham, North Carolina 27706.

## **Cooperative Program in Teacher Education**

**Program in Secondary Education for the M.A.T. Degree.** Selected graduates of liberal arts colleges who have not completed a teacher preparation program will be admitted to the Cooperative Program in Teacher Education to complete their requirements for a teacher's certificate and to pursue additional training in the proposed teaching field. Full-year internships with salary are arranged with cooperating public and private school systems. Students admitted to this program are required to attend the Duke summer school before their year of teaching internship. This program is designed for students preparing to teach science, English, mathematics, or social studies in junior and senior high schools. For materials describing this program, write to the Graduate School, 127 Allen Building, or to Director, Cooperative Program in Teacher Education, Department of Education, West Duke Building, Durham, North Carolina 27708.



## Cooperative Programs with Neighboring Universities

**Interchange of Registration.** (See Registration, the Reciprocal Agreements with Neighboring Universities.)

**Library Exchange.** Through a cooperative lending program graduate students of the University of North Carolina and Duke University are granted loan privileges in both universities.

**Cooperative Program in Russian and East European History.** The graduate schools of Duke University and the University of North Carolina offer a cooperative program leading to the A.M. and Ph.D. degrees in several disciplines (economics, history, literature, linguistics, political science, and sociology), with a concentration in Russian and East European Studies. Students admitted to one institution are encouraged to enroll in courses advantageous to their programs at the other institution, and to utilize the libraries and facilities of both universities. The holdings of the two libraries in Russian and East European materials are substantial and complementary. Both libraries have a policy of purchasing all significant published works in Slavic history, economics, government, geography, literature, and linguistics. Other joint activities include a monthly colloquium involving the personnel of the two institutions and distinguished visiting scholars.

A special project of the Duke program has been the assemblage of an outstanding collection of Soviet underground (*Samizdat*) literature (including letters and manuscripts) which is widely exhibited by the Committee.

A research program in Soviet economics (input-output analysis) provides special training for graduate students in this field and publishes a series of monographs under the auspices of a Ford Foundation grant.

## Center for Demographic Studies

A Population Studies Program was established at Duke University in 1963 to promote research and training in demography and human ecology. The program was renamed the Center for Demographic Studies in 1972 in recognition of its broad multidisciplinary focus and expanded research programs. The facilities of the center include a population library, extensive data bank



sources, and equipment for automated data processing. These are available to the entire Duke community.

Training under the auspices of the center leads to a Ph.D. degree within either the Department of Sociology or the Department of Economics. Although degrees are awarded through either department, the program is designed to provide an integrated cross-disciplinary training in the common specialty area of population studies. The bearing of sociological and economic theory upon the analysis of demographic phenomena is emphasized, and participation in active research projects is afforded center trainees.

In addition to course and research opportunities, which are open to interested graduate students in the University, a weekly non-credit seminar meets through the academic year for presentations by students, staff, and visiting guest lecturers.

Graduate fellowships for students in the training program are available. Inquiries may be directed to Dr. George C. Myers, Director, Center for Demographic Studies, Box 4732, Duke Station, Duke University, Durham, North Carolina 27706.

## **Duke Environmental Center**

Environmental programs exist in several departments and schools at Duke University, including botany, engineering, forestry, medicine, and zoology. The Duke Environmental Center was formed to provide better coordination among these programs and to stimulate further teaching and research in environmental subjects.

The purposes of the Duke Environmental Center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects for both students and faculty, to promote interdisciplinary environmental research, and to serve as a point of contact for University and environmental agencies and the public. The center does not offer degrees, but allows students and faculty to emphasize the environmental aspects of their studies and research by becoming affiliated with the center while remaining in their established departments and professional schools. The center sponsors a visiting speakers program, graduate and faculty seminars, and graduate and undergraduate courses in environmental studies.

A reference room containing books, periodicals, and research papers on environmental subjects is open to students, faculty, and the public in room 107A Biological Sciences Building. Information on environmental programs and courses offered at Duke and other institutions in the Research Triangle and on internships and opportunities in environmental careers may be obtained by writing or visiting the Environmental Center Office, 118 School of Engineering, Duke University, Durham, North Carolina 27706.

## **The University Program in Genetics**

The University Program in Genetics was established to provide for the coherent development of instruction and research in genetics throughout the University. The faculty of the program consists of scientists holding primary appointments in the various biological science departments. They have developed a interdepartmental graduate curriculum designed to meet the needs of students with a variety of educational backgrounds and professional objectives. Students in any of the science departments may specialize in genetics under the auspices of the interdisciplinary University Program in Genetics.

For current information consult Professor S. R. Gross, 151 Nanaline H. Duke Building, Duke University, Durham, North Carolina 27710.



## Hispanic Studies Program

The Graduate School offers an interdepartmental program of Hispanic studies leading to the A.M. and Ph.D. degrees. Students may write their theses and take their degrees in history, economics, political science, sociology, or Hispanic languages and literature. The purpose of the program is to provide a desirable combination of courses on the Hispanic world in these disciplines and to give candidates more rigorous training in Hispanic studies. In consultation with the candidate, a faculty committee will determine a special program of study.

The holdings of the Duke University Library for graduate work and research in Hispanic American history, inter-American relations, economic history, politics, art, and Spanish American literature are constantly being enlarged.

## Medical Scientist Training Program

The Medical Scientist Training Program, conducted under the auspices of the Graduate School and the School of Medicine, is designed for students with a strong background in science who are motivated toward a career in the medical sciences and academic medicine. It provides an opportunity to integrate graduate education in one of the sciences basic to medicine with the clinical curriculum of the School of Medicine. The program requires six to seven years of study and leads to both the M.D. and Ph.D. degrees. Although the special emphasis of this program is on basic medical science, the trainees, because of their education in clinical medicine, have a remarkable range of career opportunities open to them. Graduates of this program generally follow one of two broad paths. Some directly pursue careers in teaching and research in one of the basic medical sciences, while maintaining strong ties with clinical science as a result of their combined training; others enter residency programs before pursuing investigative and teaching careers in clinical medicine, carrying with them strong academic backgrounds in the basic sciences.

**Eligibility.** Applicants must meet the admission requirements of both the Graduate School as a candidate for the Ph.D. degree and the Medical School as a candidate for the M.D. degree. Most candidates apply for admission to the first year of the program, but applications are accepted from students who are in residence in the Graduate School or Medical School of Duke University. In addition to the minimum requirements for acceptance in the Graduate School and the Medical School, advanced course work in science and mathematics as well as prior research experience counts heavily in the selection of candidates.

**Financial Support.** Students admitted to the first year of the program in 1976 will receive a traineeship award, consisting of a stipend and full tuition allowance, provided by a grant from the National Institutes of Health. The annual stipend is \$3,900 for the first four years of the program and \$5,000 plus \$600 per dependent in subsequent years. Support will be continued until the trainee has completed both degrees, provided progress remains satisfactory.

**The Training Program.** This program has been designed to offer trainees latitude in the selection of course material. Basic requirements are two academic years composed of the first basic science year and the second clinical science year of the curriculum for medical students at Duke University. Following completion of the second year, the trainee enters the graduate program to complete the requirements for the Ph.D. degree. A final academic year of elective clinical study is necessary to complete the requirements for the M.D. degree. Both degrees are awarded at the completion of this sequence.



Additional information may be obtained by writing Professor Henry Kamin, Associate Director, Medical Scientist Training Program, Department of Biochemistry, Duke University Medical Center, Durham, North Carolina 27710.

## **The Medical Historian Training Program**

The Medical Historian Training Program is conducted under the auspices of the School of Medicine and the Graduate School to provide professionally trained medical historians. A minimum of six years of graduate study is required. Upon satisfactory completion of the program, the M.D. and Ph.D. degrees will be awarded. It is anticipated that graduates will undertake a minimum of one year of postgraduate medical training, following which their major effort will be in teaching and scholarly activities in the field of the history of medicine. They also may have minor clinical responsibilities.

Basic requirements are two academic years in the School of Medicine consisting of "core" basic sciences in the first year, ending with the course Introduction to Clinical Medicine, and "core" clinical sciences during the second year, following which the student enters the Department of History in the Graduate School.

Candidates for the Ph.D. degree in history devote approximately two full years to the completion of their required courses, work in seminars, and preparatory study for the preliminary or qualifying examination. The actual length of time needed to earn the Ph.D. degree depends upon the number of years beyond the two years candidates find necessary for researching and writing dissertations. Candidates will pursue studies in the Department of History during the third and fourth academic years of the program. In the fifth and sixth years, the student should have one year in which to pursue medical-historical research and one year of elective courses in the School of Medicine to fulfill the requirements for the M.D. degree. This elective year in clinical science is entered only after completion of all requirements for the Ph.D. degree.

**Application and Admission Procedures.** Applicants must meet the requirements for admission to the School of Medicine and the Graduate School in the Department of History. Candidates who have completed two years of medical school will also be considered.

In addition to the minimum requirements established by the School of Medicine and the Graduate School, courses already taken in history and the history and philosophy of science will count heavily in the selection of candidates.

Applicants should complete and submit an application to the Graduate School for admission to the Department of History.

Additional information may be obtained by writing to Seymour Mauskopf, Ph.D., Director, Medical Historian Training Program, Box 206, East Duke Building, Durham, North Carolina 27708.

## **Institute of Policy Sciences and Public Affairs**

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the Master of Arts degree and a doctoral or professional degree. Such a program is designed to foster the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees. With the exception of those already possessing doctoral or professional degrees, all graduate students in the Institute must pursue a concurrent degree in another



department or school at Duke or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to other graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that required by their doctoral or professional degrees.

The joint degree curriculum involves a minimum of ten courses to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy research sequence, in which the student works closely with faculty in a tutorial or a small group, stresses the development of analytical skills applicable to the broad range of policy areas.

Further information may be obtained from the Director of Graduate Studies, Institute of Policy Sciences and Public Affairs, 109 Old Chemistry, Duke University, Durham, North Carolina 27706.

## Oak Ridge Institute of Nuclear Studies

Duke University is one of the sponsoring universities of the Oak Ridge Associated Universities located at Oak Ridge, Tennessee. The graduate research program at Duke has available to it all the facilities of the Oak Ridge National Laboratory and the cooperative supervision of student research by the staff at Oak Ridge. Fellowships in several fields of science are available to qualified applicants.



**Graduate Fellowship Program.** On application by a university, ORAU awards fellowships to candidates for the master's and doctor's degrees. The student uses the fellowship to conduct thesis research in an Oak Ridge laboratory.

The application deadlines depend upon the fellowship. Further information may be obtained from Boyd R. Strain, Department of Botany, Duke University, Durham, North Carolina 27706.

## Organization for Tropical Studies

Duke University is a member of a consortium created to promote an understanding of tropical environments and their intelligent use by man. To achieve these objectives, the Organization for Tropical Studies (OTS) fosters research and educational programs in the New World tropics.

Fellowships are available for travel and subsistence in field-oriented programs in Central America. The basic course, *Tropical Biology: An Ecological Approach*, runs for an eight-week period in January-February and in July-August. Advanced offerings are periodically scheduled in agriculture, anthropology, botany, earth sciences, forestry, geography, marine biology, meteorology, and zoology.

The course schedules and application deadlines vary from year to year. Consult Dr. Donald Stone (Botany), Dr. Peter Klopfer (Zoology), or their respective departments for information.

## Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. A



participating student is based in one of the regular departments and fulfills the Ph.D. degree requirements for that discipline. In addition, he takes a program of electives which will advance his interdisciplinary competence in the medieval or Renaissance areas. Such a program may include a choice from the fields of art history, language and literature, history, philosophy, and religion. Participation in the Program in Medieval and Renaissance Studies will fulfill the requirement for work in a related field.

The Committee on Medieval and Renaissance Studies awards annual fellowships to outstanding doctoral students. Each fellowship is renewable twice, with renewal based on a review of the student's program by the committee.

The Committee on Medieval and Renaissance Studies sponsors also an undergraduate program, the *Journal of Medieval and Renaissance Studies*, a monograph series in the field, and lectures by distinguished visiting scholars.

Inquiries should be addressed to the Chairman, Duke University Committee on Medieval and Renaissance Studies, Box 4666, Duke Station, Durham, North Carolina 27706.

## Social Systems Simulation Program

This is an interdisciplinary program to stimulate the use of model building and computer techniques in the social sciences. An outgrowth of the Econometrics Program, the program is broadly based involving the participation of faculty from business administration, economics, education, mathematics, political science, psychiatry, psychology, and sociology. It provides resources and facilities for predoctoral students pursuing the Ph.D. degree in a variety of fields. Inquiries should be addressed to the Director, Social Systems Simulation, Economics Department, Durham, North Carolina 27706.





## Center for Southern Studies

The Center for Southern Studies engages in interdisciplinary inquiries into both the contemporary and historical South. It is concerned both with scholarly research and its practical application in the emerging industrial states of the region and has been instrumental in the creation of a multi-state Southern Growth Policies Board to foster regional economic planning. Under the auspices of the Board, southern business, labor, educational and political leaders, including nine governors, are engaged in developing modern approaches to basic problems.

The center's Oral History Project focuses upon developing additional Black sources on the southern past in hopes of fostering a multi-racial history of the region. The center is also cooperating with the Department of History in training graduate students in the methods of oral research.

The center offers an interdisciplinary undergraduate course entitled *The Changing South* (IDC 199) which explores the geography, economics, politics, and culture of the region. The staffs of the center and the Perkins Library have created a Center for Southern Studies Reading Room containing over 300 volumes relating to the historical and contemporary South.

Inquiries relating to the Oral History Program should be addressed to Dr. Lawrence Goodwyn or Dr. William Chafe, 219 Old Chemistry Building, Duke University, Durham, North Carolina 27706.

## Predoctoral Training Program in Sciences Related to the Nervous System

This training program is designed to develop scientists with a broad understanding of the current status, techniques, and approaches of the disciplines contributing to our knowledge of the nervous system, behavior, and mental health. Participants work toward the Ph.D. degree in one of the following participating departments: anatomy, microbiology and immunology, physiology and pharmacology, biochemistry and genetics, pathology, or psychology. In lieu of the minor field of study, they have an expanded curriculum, tutorial courses, and seminar series in the current issues of neurobiology. Each curriculum is structured by a committee to satisfy the individual's needs and interests. This program is especially designed to develop individuals who have a broad understanding of the neurosciences and are equipped to contribute to the expansion of knowledge through research in their fields. Further information may be obtained by writing Frans F. Jöbsis, Ph.D., Chairman, Training Committee, P.O. Box 3709, or Walter D. Obrist, Ph.D., Program Director, Duke University Medical Center, Durham, North Carolina 27710.



## Resources for Study



## The Libraries

The William R. Perkins Library has shelf space for 1,500,000 books, seats for 1,250 readers, and a staff of 200. Since renovation of the old building was completed in the spring of 1970, the complex has provided room for 2,500,000 books and 2,100 readers. Study space includes nearly 700 carrels, 200 closed and 500 open, of which 475 are in the new building.

On the main floor—at ground level—are the reference and loan departments, bibliography, current periodicals, interlibrary loan, and all units of technical processing. Documents, newspapers, a microtext collection, as well as a microphotography laboratory and other copying facilities are located on the floor below. The administrative offices and graduate reading room are on the second floor, with manuscripts and archives on the third. Twelve small reading and study rooms are provided in the stacks for the departments in the humanities and social science which grant the doctorate. Four seminar rooms are also located in the stacks.

Microphotography and photographic services utilize modern equipment for reproducing printed and manuscript materials and for the reading of materials in the microtext collection. A special room is available to film readers.

The combined University libraries, including Perkins Library and nine school and departmental libraries, contained 2,622,167 volumes in the summer of 1975. The Perkins Library had 1,604,813 volumes; the Undergraduate Library, 17,461 volumes; Divinity School, 175,611 volumes; Engineering, 53,974 volumes; Law, 193,204 volumes; Medical Center, 139,135 volumes; East Campus Library, 179,746 volumes; Biology-Forestry, 119,028 volumes; Chemistry, 33,228 volumes; Mathematics-Physics, 49,933 volumes; and Music 43,559 volumes. Over 92,000 volumes were added in 1974-75. Approximately 12,500 periodicals and 208 newspapers are received currently.

The extensive resources of the Library for research students may be suggested by the following special collections:

The Trent Collection of Walt Whitman, containing the first, as well as all other important early editions or issues of *Leaves of Grass*; books and articles of Whitman biography and criticism; nearly 300 manuscripts, 400 letters, pictures, sheet music, and other miscellany.

The George Washington Flowers Collection of books, manuscripts, pamphlets, and newspapers on all phases of Southern history.



The Arents Collection of several hundred volumes relating to the culture and production of tobacco and the manufacture and distribution of tobacco products.

The James A. Thomas Collection of books on Chinese history and culture.

The Guido Mazzoni Library, a collection of approximately 23,000 volumes and 67,000 pamphlets covering Italian literature, with special strength in the nineteenth century.

The Gustave Lanson Library of 12,000 books and monographs on French literature.

Latin-American Collections, built around a Peruvian library of 7,000 books and manuscripts, a Brazilian library of several thousand volumes, and an Ecuadorian library of 2,000 volumes, supplemented by strong collections of the public documents of these and other Latin-American countries.

The Robertson Library of Philippiniana.

The Frank C. Brown Folklore Collection, consisting of about 38,000 manuscript pieces, 1,400 vocal recordings, and 650 musical scores of North Carolina folklore.

The Strisower Library of international law, numbering nearly 5,000 volumes, with rare books and periodical files.

The Trent Collection in the History of Medicine, (Medical Center Library), containing about 3,000 books and 2,500 manuscripts with special strength in anesthesia, anatomy, English medicine, vaccination, yellow fever, pharmacy, and medical biography.

The Holl Church History Library, dealing primarily with the period of the Reformation.

The Frank Baker Collection of Wesleyana and British Methodism, consisting of 1,500 editions of the works of John and Charles Wesley, 8,000 volumes concerning all phases of the development of British Methodism, 4,000 volumes relating to the religious and social background of British Methodism, and 4,000 manuscript pieces by the Wesleys and their coadjutors and by British Methodists of the last 200 years.

Collections in English and American literature, with emphasis on the eighteenth and nineteenth centuries, with the collections of Swinburne, Tennyson, Rossetti, and Bryant, significant groups of annotated copies and first editions of Coleridge and Byron, the Carroll Wilson collection of Emerson, some 5,000 items of eighteenth century English poetry and prose, and the Paul Hamilton Hayne Library of American literature.





In addition to these and other special collections, the libraries contain excellent files of United States federal and state documents, public documents of many European and Latin American countries, and publications of European academies and learned societies. The newspaper collection, with 15,000 volumes and 30,000 reels of microfilm, has several long eighteenth century files; strong holdings of nineteenth century New England papers and of antebellum and Civil War papers from North Carolina, South Carolina, and Virginia; and many European and Latin American papers. The manuscript collection of over 4,500,000 items is particularly strong in all phases of the history, politics, and social and economic life of the South Atlantic region and includes significant papers in English and American literature. The collection of 137 Latin and 65 Greek manuscripts constitutes one of the outstanding collections of its kind in the United States.

## Science Laboratories

**Botanical and Zoological Laboratories.** Facilities for graduate study in the Departments of Botany and Zoology are located on the West Campus. The Biological Sciences Building, completed in 1962, contains well-equipped modern laboratories for teaching and research in the fields of botany, forestry, and zoology. Special facilities include animal rooms, greenhouses, darkrooms, refrigerated and controlled-environment laboratories, scanning and transmission electron microscopes, a Van de Graaf accelerator, X-ray machines, radiation and radioisotope equipment, and other modern research facilities. Extensive facilities for experimentation in environmental control of plant growth are available in the phytotron adjacent to the botany greenhouses.

The herbarium contains over 360,000 specimens and includes notable collections of mosses and lichens. Other unique assets for teaching and research are the Sarah P. Duke Gardens on the West Campus; the four-acre experimental plot and field laboratory developed by the Department of Botany; the Duke Forest, comprising 8,000 acres of woodland adjacent to the West Campus; the field station for the study of animal behavior; and the Duke University Marine Laboratory at Beaufort, North Carolina. Duke University, through the Botany and Zoology Departments, is a member institution of the Organization for Tropical Studies in Costa Rica, a facility which provides opportunities for course work and research in tropical flora and fauna.

Scholarships for advanced study during the summer months are available through the Highlands Biological Laboratory, Highlands, North Carolina. Requests for information concerning scholarships at the Highlands laboratory should be addressed to the Botany Department.

**The Phytotron.** The phytotron, officially known as the Duke University unit of the Southeastern Plant Environment Laboratories, is adjacent to the Biological Sciences Building and is administered by the Botany Department. The phytotron is an integrated series of plant-growth rooms, chambers, and greenhouses with forty-six separately controlled environments providing more than 4,000 square feet of plant-growing space. The factors of the environment controlled in the units to study plant growth include light, temperature, nutrients, CO<sub>2</sub> concentration, and humidity. By using the conditions in various day and night combinations, an exceptionally large number of environments can be simulated for testing the growth responses of plants. The phytotron also includes research laboratories and facilities for studying and monitoring the physiological processes of plants.

Research space in the phytotron is available to graduate students and faculty at Duke and to members of other educational and research organizations. For

information concerning awards and research space, contact Dr. Henry Hellmers, Director of Phytotron, Department of Botany, Duke University, Durham, North Carolina 27706.

**Marine Laboratory.** The Duke University Marine Laboratory is located at Beaufort, North Carolina, less than two miles from the open ocean. The physical plant includes six well-equipped research buildings, seven classrooms, and five dormitories, three of which are heated and air-conditioned for year-round use. The Laboratory provides excellent facilities for summer graduate courses in botany, chemistry, geology, zoology, biochemistry, and physiology and for thesis research throughout the year. Special research and training facilities for field work in marine biology and biological oceanography include three motor vessels and a 118-foot oceanographic research vessel, *Eastward*, complete with apparatus for collecting and taking environmental measurements.

For information concerning research space, write to Dr. John D. Costlow, Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. For information concerning courses refer to Marine Sciences—the University Program in the section on Courses of Instruction.

**Animal Behavior Station.** The Animal Behavior Station, located less than one mile from campus, provides facilities for the study of penned, freeranging, and caged animals in a wooded area of eighty acres. These facilities include soundproofed observation chambers, barns, aviaries, and pens for large animals, and birds, and two waterfowl ponds. An extensive facility for the study of prosimian primates was completed in 1968. It contains one of the world's largest collections of lemurs in rooms especially designed for observational and behavioral studies. For information regarding research space or research assistantships in animal behavior, write to Dr. P. H. Klopfer, Department of Zoology, Duke University, Durham, North Carolina 27706.

**Primate Facility.** The Duke University Primate Facility is located in the Duke Forest adjacent to the Animal Behavior Station, approximately two miles from the main campus. The colony is composed of approximately 200 prosimian primates representing twelve species. The animals are utilized by faculty members and students in the Departments of Anatomy, Anthropology, Psychology, and Zoology for research in cytogenetics, comparative anatomy, animal behavior, and physiology. Information concerning graduate study in one of these areas should be directed to the director of graduate studies of the respective department. For information pertaining to the use of the Primate Facility and availability of research space write to Dr. J. A. Bergeron, Managing Director, Duke University Primate Facility, 3705 Erwin Road, Durham, North Carolina 27705.

**Physics Laboratories.** The Physics Building, containing about 130,000 square feet of floor space, is devoted to research and instruction in the Departments of Physics and Mathematics. An additional 27,000 square feet of space are provided in the adjacent Nuclear Physics Building completed in 1968. Graduate students are provided with office space in one of these two buildings.

In addition to the lecture halls and the elementary laboratories, there are instructional laboratories for work in electronics and advanced physics.

Nearly half the building is devoted to special laboratories for research in microwave spectroscopy and atomic, nuclear, high energy, low temperature, and solid state physics. Special equipment includes microwave spectrographs operating up to 500,000 megacycles; one 4 MeV and one high resolution 3 MeV Van de Graaf accelerator, a 30 MeV cyclotron/tandem Van de Graaf accelerator, a helium liquefier, cryostats, magnets, and associated equipment for research down to the millidegree Kelvin temperature range; a Sigma-5 and a DDP-24 computer used for automatic measurement and processing of bubble chamber film in the High

Energy Physics Laboratory; and two DDP-224 computers used to collect and process data in the Nuclear Structure Laboratory.

The Physics-Mathematics Library contains a large selection of books and periodicals. A spacious, well-equipped instrument shop located in the buildings is staffed by ten instrument makers, ten electronics technicians, and a glass blower.

**Chemistry Laboratories.** The Department of Chemistry is housed in the Paul M. Gross Chemical Laboratory, a building containing three and one-half floors providing 146,440 square feet of total area. The Chemical Laboratory is well equipped and provides conditions conducive for research in many areas of current interest. Nuclear magnetic resonance facilities includes 60 MHz, 100 MHz, and Bruker 90 MHz spectrometers. The latter instrument is equipped with a complete range of decoupling accessories as well as Fourier transform capabilities for  $^{19}\text{F}$ ,  $^{15}\text{N}$ ,  $^{13}\text{C}$ ,  $^{31}\text{P}$ , and  $^1\text{H}$  nuclei. Two ESR spectrometers, including a Varian E-9, provide excellent facilities for research in electron spin resonance. Mass spectrometric service is provided by a CEC 21-490 mass spectrometer as well as access to an A.E.I., Ltd., MS-902 located in the Research Triangle Park. X-ray diffraction cameras of all types are available along with Enraf-Nonius automatic and Picker automatic full-circle diffractometers. Numerous instruments of varying sophistication for fluorescence, infrared, u.v., and ORD-CD spectroscopy are available. Several preparative and analytical gas and liquid chromatographs are also located in the building. Computing facilities include PDP-81L and PDP-81F laboratory computers and an IBM 370-165, the latter located in the Research Triangle Park and linked by cable to the Duke University Computation Center. The department has a machine shop, an electronics shop, and a glassblowing shop. The facilities of the Duke University Marine Laboratory on the coast of Beaufort, North Carolina, are available for specimen collecting and processing studies of organic chemicals of marine origin. The Department of Chemistry Library is also located in the Paul M. Gross Chemical Laboratory; it has holdings of some 30,000 volumes and receives some 330 current scientific periodicals.







**The Nanaline H. Duke Building.** The Nanaline H. Duke Medical Sciences Building offers a superb environment for the creative research and education of faculty and graduate students in the Departments of Biochemistry, and Physiology and Pharmacology. The building provides more than 65,000 square feet of laboratory space arranged in four towers around a central service core. Individual laboratories are designed to meet the special needs of research programs dealing with living organisms. Controlled environment rooms, dark-rooms, materials-purchasing facility, electronics shops, a library, and conference and reading rooms are provided. A vivarium for the temporary care and treatment of experimental animals is also located in the building.

**Psychology Laboratories.** The Psychology Department occupies approximately 53,000 square feet of air-conditioned space on the main campus. Housed there are general purpose laboratories, seminar rooms, classrooms, and a number of special facilities. For the study of animal behavior there are videotape-recording facilities, a breeding colony of ring doves and pigeons, an extensive collection of prosimians, and operant-conditioning laboratories. There are soundproofed and electrically shielded rooms for use with human and animal subjects; rooms for computer-controlled experiments in human perception and memory; photographic darkrooms; electrophysiological recording rooms; and a histological laboratory and surgery. The social psychology unit (used jointly with the Department of Sociology) contains observation, communication, and videotape-recording facilities for the study of social interaction. There are interview and observation rooms for the study of human personality and clinical processes and a fully equipped experimental trailer for studying the behavior of children on location. Both laboratory computers and remote access to the IBM 370 Model 165 located at the Triangle Universities Computation Center are available in the building. Machine, wood, and electronics shops are staffed by three full-time technicians. Other facilities for research and teaching are available in the laboratories and clinics of the adjacent Duke Medical Center.

A number of clinical installations for adults and children, specializing in clinical and guidance problems, cooperate with the department in providing facilities for research and training. In addition, the department operates an experimental school for first- and second-grade and preschool children, and cooperates with the Department of Zoology in operating an eighty-acre field station and primate facility in nearby Duke Forest for the study of animal behavior in natural settings (see Animal Behavior Station).





**Computation Center.** The Duke University Computation Center, available to faculty and students for research and instruction, is presently equipped with an IBM System 370 Model 135 (320K bytes, one 3330 disk facility, three tape drives, two card readers, two printers, and a digital X-Y plotter) which is connected by a high-speed microwave link to an IBM System 370 Model 165 (four million bytes of memory, two 3330 and one 2314 disk facility, seven tapes, card reader, and printer) located at the Triangle Universities Computation Center (TUCC) which is in the Research Triangle Park. There are several low-speed keyboard terminals in addition to three medium-speed terminals (card reader and printer) located in the Engineering Building, the Sociology-Psychology Building, and the Biological Sciences Building.

The Triangle Universities Computation Center is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill.

Faculty members at Duke may use these facilities by filling out an application for computer services. All users of the Computation Center facilities are urged to obtain funds to pay for computer services; however, any user unable to obtain grant funding may ask for financial support from his department when he applies for the services.

More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

**Engineering Research Laboratories.** The laboratories of the four departments of the School of Engineering contain extensive basic equipment that may be applied in several specialized fields. Each laboratory also contains selected sophisticated equipment used in advanced research. The facilities available for instruction and research are suggested by a brief listing of items found in each department:

*Biomedical Engineering.* Holography and ultrasound apparatus; high energy CW helium-neon gas laser, and interferometrically stable table; cellular electrophysiology and neurophysiology instrumentation; stereomicroscope, micro-manipulators, stimulators, isolation units, and microelectrode puller; facilities for studying biomedical materials and surface interactions; polarizing microscope, internal reflectance infrared spectrophotometer, and dialyzers; cardio-respiratory measurements; respirator, pressure transducers, and DEC PDP-12 digital computer.

*Civil Engineering.* Well-equipped research laboratories are available for work in environmental engineering, soil mechanics and geotechnical engineering, solid mechanics and materials engineering, structural mechanics and structural engineering, fluid mechanics, water resources and ocean engineering, and urban systems and transportation engineering. Available research facilities include: two independent closed-loop electrohydraulic dynamic loading systems (MTS) capable of applying pulses of any shape and controlled in force or displacement modes, frequency range up to 100 cps., load capacity 6,000 and 100,000 lbs. (the 6,000 lbs. actuator can develop a constant crosshead speed up to 50,000 in./min.); equipment for manufacture and testing of fiber-reinforced polymer composites; environmental chamber for testing in the temperature range of -320° to 500° F., ultra-high-pressure triaxial shear apparatus for confining pressures up to 100,000 psi.; high-speed camera for studying explosions and similar phenomena; particle tracking X-ray equipment for soil deformation studies; rock-testing facilities; model-testing equipment for anchored walls, penetrometer studies, and deep pile foundations; large-aperture research polariscope; and a reflective photoelastic polariscope; sustained-loading facility for long duration in studies of prestressed concrete; and a PDP-8 digital computer with an 8K core memory size, teletype console, paper tape and magnetic tape I/O capabilities, and teletype terminals which are also connected to the IBM 370/165 computer in the Triangle Universities Computation Center.

*Electrical Engineering.* Digital data processing laboratory equipped with DEC PDP-81 and PDP-11/45 computers including graphic displays, X-Y tablets, and remote input-output terminals; microwave facilities for experimentation up to 35 GHz; X-ray diffractometer with monochromator and low temperature attachments; cryomagnetic Faraday balance for magnetic susceptibility measurements; EPR spectrometer; 4 inch and 9.5 inch electromagnets; and 2 inch-bore superconducting magnet.

*Mechanical Engineering and Materials Science.* Digital data acquisition system with high speed scanner and magnetic tape; FM-AM instrumentation recorder; 4 square foot subsonic wind tunnel with six-component balance; hot-wire anemometer system; storage and dualbeam oscilloscopes; X-Y and strip chart recorders; temperature, pressure, strain, force, and acceleration transducers; electrodynamic shaker table; sound room; spectrum analyzers; MiniAC and TR-20 analog computer facilities; D17B Minuteman digital minicomputer; CRT Data I/O terminal with hardcopy unit; fuel research engine; materials laboratories with stereo zoom research metallograph, polarizing and low-temperature microscopes, electron microscope, thermal analyzer, Instron testing machine, high vacuum system, instrumented plastics extruder and injection molder, 10 kw

RF generator, heat treating and arc-melting furnaces, recorders, constant load stress corrosion tester, and darkroom facilities.

The School of Engineering is associated with the F. G. Hall Laboratory for Environmental Research at the Duke University Medical Center where opportunities are provided for research in environments from pressures of 1 Torr (155,000 feet of altitude) to 446 psig (1000 feet of depth in sea water) with a variety of gases, temperatures, and humidities. All basic equipment for measuring and recording physiological and physical phenomena are provided. Experiments may be performed in vitro or in vivo with animals or human subjects. Areas of interest have been in heat and mass transfer, fluid flow, and thermal regulation.

The shop facilities of the School, as well as those located elsewhere on campus, are available to graduate students in all four departments.

The School of Engineering houses an IBM Model 2780 medium-speed card-reader punch and printer which communicates directly with the IBM System 370 Model 165 computer located in the Triangle University Computation Center in the nearby Research Triangle Park.

**Forestry Sciences Laboratory.** The U. S. Forestry Sciences Laboratory of the Southeastern Forest Experiment Station is located in the Research Triangle Park near Durham. This research organization provides excellent opportunities to complement research conducted by students in the Department of Forestry and Environmental Studies. Specialized research projects in forest entomology, pathology, physiology, and soils are currently underway at the laboratory. The staff of the laboratory is available for consultation and participation in seminars. Arrangements may be made for students to conduct certain aspects of their research at the laboratory.

**Duke Forest.** The Duke Forest serves as an outstanding field laboratory for the students and faculty of Duke University. This forest consists of nearly 8,000 acres on which grow various types of forests characteristic of the southeastern Piedmont region. Shortleaf pine, loblolly pine, and southern hardwoods represent the main timber types.

Much of the Duke Forest is adjacent to the campus and easily accessible. This provides students and faculty with excellent opportunities to conduct studies in various fields of forestry such as ecology, entomology, land management, meteorology, pathology, physiology, and soils.





## Student Life





## Living Accommodations

Duke University offers varied living accommodations to married and single graduate students. A brief description of each follows:

**Graduate Center.** Only one residence hall is presently available for single graduate and professional men and women. This facility has been described as adequate and convenient. There are some disadvantages, however, such as the lack of single rooms and private baths, and long corridors.

The Graduate Center, located near the Duke Medical Center, houses a limited number of graduate and professional students, both men and women. The upper floors house undergraduates. Commons areas on the main floor and dining facilities on the ground floor are shared by all students who reside in the house.

The limited number of single rooms, located in the men's section only, are usually reserved by previous occupants for the following academic year. Other rooms are equipped for two persons.

Freshman medical students residing at the Graduate Center will be required to move to summer housing on West Campus after Commencement and to pay additional summer fees. The Graduate Center closes during the summer sessions.

**Town House Apartments.** Town House Apartments, located in the Central Campus area, is a 32-unit complex, which also houses graduate and professional school students. These apartments are more spacious than the apartments found on campus or in Durham. Because of its location away from the academic facilities of the three campuses, students find that these apartments offer a change from normal campus life and activities. These apartments are available for continuous occupancy, summer months included.

Some two-bedroom apartments are furnished for two single graduate students. The remaining apartments are furnished for three students. Choice of the single bedroom is determined by the occupants residing in each apartment for three students.

Each air-conditioned apartment includes a living room, master bedroom, bath and a half, a single bedroom, and an all-electric kitchen with a dining area. Spacious closets and storage spaces are provided within each apartment.

Occupants must make arrangements and pay for electricity, gas, and telephone service with the local utility companies..

**Central Campus Apartments.** During 1975, Duke University completed a 500-unit apartment complex. These units are also available throughout the calendar year for continuous occupancy.

Apartments will be available for single and married students attending the graduate and professional schools and undergraduate colleges as well as all categories of students receiving instructions in the various allied health courses of the Medical Center.

For single graduate professional students, one-bedroom and three-bedroom apartments will be fully furnished; a few furnished efficiencies are also available. It is expected that many more applications will be received for efficiencies than can be accommodated.

**Application Procedure.** The Department of Housing Management provides students accepted to the University with housing application forms and detailed information on rates, rental agreements, and availability of housing. A completed and returned application form, accompanied with the required \$50 residential deposit, will reserve a housing unit.

## Food Service

**West Campus and Graduate Center.** The dining facilities on West Campus include two cafeterias with multiple-choice menus. The Oak Room has waitress service and offers full meals and a la carte items. The Cambridge Inn, a self-service snack bar open throughout the day and evening, is located in the West Campus Union. The Graduate Center has a public cafeteria and a coffee lounge, which is open until midnight.

**East Campus.** On the East Campus there are two dining halls which serve cafeteria-style meals. Although designed to serve the residents on East Campus board plans, all other students may take meals there at the guest rate. Due to the large number of students served in the dining halls, it is not possible to provide special diets.

The cost of meals to non-board students approximates \$3 to \$4 per day, depending on the needs and tastes of the individual.

## Services Available

**Medical Care.** The aim of the University Health Service is to provide any medical care and health advice necessary to the student as a member of the University community. The Health Service maintains the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation can be obtained from the Duke Campus Police.

The University Health Program is currently being evaluated in terms of costs and coverage; therefore, beginning with the 1976-77 academic year a separate fee for this service may have to be assessed.

The Student Health Program offers varied benefits. To secure these benefits a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until he has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, or (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

Under this program the University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the clinic for the treatment of acute illness or injury, and advice and assistance in arranging

consultation for medical treatments. Fees for such consultations or treatments must be paid by the student if he is not covered by an insurance plan.

Under this program the facilities of the University Infirmary are available to all currently enrolled full-time students in residence during the regular session from the opening of the University in the fall until Graduation Day in the spring. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined to the infirmary.

The Student Mental Health Service, located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment of matters ranging from questions about normal growth and development to the most serious psychiatric disorders. Students may have up to four appointments per year with the Student Mental Health Service at no charge. Further interviews can be arranged, either with this staff or with a variety of other professionals, at a fee commensurate with the student's ability to pay.

All Duke University Medical Center resources are available to all Duke students and their spouses and children, although any bills incurred at Duke Hospital or any other hospital are the responsibility of the student, if he is not covered by an insurance plan. The Student Health Program does not provide health care for spouses and dependent children of married students. Coverage of the married student's family is provided in the University's Student Accident and Sickness Insurance Plan for an additional fee.

The University has made arrangements for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. For additional fees a student may obtain coverage for a spouse and child. Although participation in this program is voluntary, the University expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. *Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement.* The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. Term of the policy is from opening day in the fall. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

**The Duke University Counseling Center.** Through the Counseling Center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. The staff conducts continuing research in counseling and testing.

**Office of Placement Services.** Duke University maintains an Office of Placement Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to





talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions, and to have a permanent file for future reference. Pertinent recommendations should be accumulated while a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year for students registered with the Office of Placement Services.

## Student Affairs

**Cocurricular Activities.** Graduate students at Duke University are welcome to use such recreation facilities as swimming pools, tennis courts, golf course, and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the Graduate Women's Club.

A full program of cultural, recreational, and religious activities is presented by the Associated Students of Duke University, Cultural Affairs Office, Duke University Christian Council, Duke University Parish Ministry, Duke University Union, Student Activities Office, and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the *Duke University Annual Calendar*; detailed and updated information in the *Weekly Calendar*, available on each Friday; and the *Duke Chronicle*, available each Monday through Friday. Copies may be obtained at the Information Desk or the Calendar Office, Page Building.

**Graduate Student Association.** The Graduate Student Association provides a formal means of communication between the graduate student body and the faculty and administration. Membership in the association is open to all registered graduate students. This student-organized association meets monthly, with representatives present from the graduate enrollment of each department.



It is governed by a steering committee elected annually from the membership and, among other functions, provides graduate student representation on campus committees including those concerning the library, housing, and governance.

## Research and Publications

The departments of Duke University are devoted to research as well as to instruction. Since a prime purpose of the University is the promotion and diffusion of knowledge, attention in the Graduate School is focused on research and publication.

To this purpose, the Provost annually appoints a University Research Council which receives applications from members of the various faculties for subsidies in support of research. Forward-looking policies of this council have encouraged the initiation and completion of substantial research projects.

The Duke University Press was created in 1925 as a successor to the Trinity College Press. It continued the publication of the *South Atlantic Quarterly*, published at Trinity College since 1902, and in 1926 it revived the *Hispanic-American Historical Review*, which had been founded and published from 1918 to 1922 by a group of scholars interested in Hispanic America. In 1929 *American Literature* was begun with the cooperation of the American Literature Group of the Modern Language Association. This journal was followed in 1931 by *Ecological Monographs*, and in 1932 by *Character and Personality* (since 1945 entitled the *Journal of Personality*). In 1935 the press began the publication of the *Duke Mathematical Journal*. Since 1948 it has published *Ecology*, the official journal of the Ecological Society of America. In 1965 it began publication of *American Literary Scholarship* (an annual), in 1969 the *History of Political Economy*, and in 1971 the *Journal of Medieval and Renaissance Studies*. The press has since assumed the publication of the *Bulletin of the Ecological Society of America* (1970) and *Law and Contemporary Problems* (1975), formerly published by the School of Law. Publication of the *Journal of Health Politics, Policy, and Law* will begin during the current academic year.

Since its organization the press has published over five hundred volumes. Included are seven series: the Duke Historical Publications, the Duke Studies in Religion, the publications of the Lilly Endowment Research Program in Christianity and Politics, those of the Program in Comparative Studies on Southern Asia, Monographs in Medieval and Renaissance Studies, Publications of the Consortium for Comparative Legislative Studies, and, largest of all with forty-two volumes to date, the publications of the Duke University Center for Commonwealth Studies. In the broadest sense, the policy of the press is to make available to the public any scholarly work that merits publication, though special attention is given to works in fields of knowledge cultivated by the University.

## Visiting Scholars

The libraries and other facilities of Duke University are made available, to the extent practicable, to faculty members of other colleges and universities who wish to pursue their scholarly interests on the Duke campus. Identification cards are furnished visiting scholars by the Graduate School Office. Such visitors are not charged unless they wish to participate in activities for which a special fee is assessed. Assistance in finding housing is available from the Department of Housing Management. Inquiries pertaining to visiting scholars should be addressed to the department chairman concerned or the Dean of the Graduate School.



Admission



## Students Requiring Admission

Admission is required of (1) all students who intend to pursue study toward a degree offered by the Graduate School, (2) all other students who register as Special Students in the summer session. Students who have discontinued a program of study after earning a master's degree here must by letter request permission of the Dean to undertake a doctoral program. All applicants are considered without regard to race, color, religion, sex, or national origin.

## Prerequisites

A student seeking admission to the Graduate School of Duke University must have received an A.B. or B.S. degree (or the equivalent in the case of foreign students) from an accredited institution. The student's undergraduate program should be well rounded and of such quality as to give positive evidence of capacity for graduate study. Usually the student should have majored in the area of intended graduate study. Many departments (see the chapter on Courses of Instruction) list specific prerequisites. Students are urged to anticipate the language requirement and are reminded that Educational Testing Service Graduate School Foreign Language tests in French, German, Russian, and Spanish are offered to undergraduate and graduate students at many centers on nationally uniform dates (see Language Requirements).

## Procedures

A student seeking admission to the Graduate School should obtain an application blank from the Dean of the Graduate School. This should be filled out completely and returned promptly. Each application must be accompanied by a non-refundable fee of \$15\* in check or money order payable to Duke University. In addition the student should provide the following supporting documents:

- (1) two copies of the official transcript from each college, university, or seminary attended sent directly to the Dean by the institution;
- (2) two supplementary transcripts, sent as soon as possible, showing completion of work which was in progress when the earlier transcript was made;
- (3) three letters of recommenda-

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\*All fees are based on current charges and are subject to change without notice.



tion, written on the forms provided, by persons best qualified to judge the applicant as a prospective graduate student, and mailed directly to the Dean; (4) scores on the Graduate Record Examination Aptitude Tests for all departments; and (5) scores on the Graduate Record Examination Advanced Test for Biochemistry, Botany, Chemistry, English, Mathematics, Microbiology, Pathology, Physics, Physiology, Romance Languages, Sociology, and Zoology.

Applicants to the Department of Health Administration are required to take the Graduate Management Admission Test, administered by the Educational Testing Service.

Students applying for financial aid in all departments should take the Graduate Record Examination no later than the October testing in order to meet the February 1 deadline. Information on the times and places of the Graduate Record Examinations can be provided by the applicant's college or the Educational Testing Service, Princeton, New Jersey 08540, or Berkeley, California 94704.

**Additional Procedures for Foreign Students.** Fully qualified students from outside the United States are welcome to take courses in the Graduate School and, in many instances, to study toward a degree. In applying for admission the foreign student must, in addition to the information required of all students, submit with the application material (1) if the student's native language is not English, certification of English proficiency demonstrated by scores from the Test of English as a Foreign Language (TOEFL), administered through the Educational Testing Service in Princeton, New Jersey; (2) a statement showing financial arrangements for the proposed term at Duke (estimated costs per calendar year are \$6,200\*); and (3) a statement by a qualified physician describing any emotional or physical illness the applicant has had during the previous five years. A foreign student must meet all these requirements before the Graduate School will make any offer of admission.

All foreign students whose native language is not English will be examined during their first registration period for competence in the use of oral and written English. Until competence is determined, admission and arrangements for an award involving teaching must remain provisional. Students found to lack necessary competence will be required to enroll in the non-credit course called English for Foreign Students and to reduce their course or research program 3 units. Tuition charge for this course will be \$48\* per unit. A student who does not successfully complete this course during the first year of residency will not be permitted to continue his graduate work at Duke University. Passing this examination or the course, if it is required, will not meet degree requirements for a foreign language. (See Language Requirements for Foreign Students.)

**Notification of Status.** When admission is approved, the student will receive a letter of admission and an acceptance form. The process of admission is *not complete* until the acceptance form has been returned. An admission offer is for the semester specified in the letter of admission.

Applicants who are admitted will be offered full admission, provisional admission, or nondegree admission. *Provisional admission* for a trial period of one semester or a minimum of 12 hours of course work is offered to students who appear to warrant admission but do not fully comply with admission requirements. Graduate credit earned under provisional status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. *Nondegree admission* is offered to students who meet the admission requirements and who desire to engage in graduate study not subject to the

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\*Figures are based on 1975-1976 charges and are subject to change before the fall, 1976, semester.





restrictions of a graduate degree program. With the approval of the student's major department and the Dean of the Graduate School, a maximum credit of 6 units earned under nondegree status may be applied toward an advanced degree at Duke University if and when the student is granted full admission. (See ruling on page 1.)

**Deadlines for Application.** It is the applicant's responsibility to make certain that the Graduate School Office has received all required material before the specified deadlines. Because applications cannot be reviewed until all supporting documents are filed, applications should be submitted at least *two weeks* before the closing dates listed below:

Fall semester, admission and award .....	February 1
Fall semester, admission only .....	July 15
Spring semester, admission only .....	November 1
Summer session, 1977* first term .....	April 15
Summer session, 1977* second term .....	May 15
Summer session, 1977* third term .....	June 15

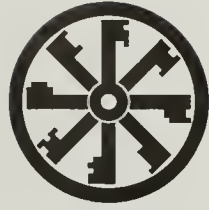
Anyone whose folder is not complete before that date will face the possibility that departmental enrollment will have been filled. While the Graduate School Office will process all applications, it can not guarantee full consideration of a folder for each department after April 15.

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\*Students seeking admission to the Graduate School for study in the summer session should make application to the Dean of the Graduate School as well as to the Director of the Summer Session.



## Financial Information



## Tuition and Fees\*

The 1975-76 tuition for all students (except those in Health Administration and Physical Therapy) for a full semester program amounts to \$1,440 (15 units at \$96 per unit). Part-time tuition is calculated at the same rate of \$96 per unit. Tuition charges are due and payable at the times specified by the University for that semester and are subject to change without notice. Registration is not considered complete and students may not be admitted to classes until arrangements have been made with the Bursar of the University for settlement of tuition and fees. A late registration fee of \$25 is charged any student not completing registration during the registration periods. The *in absentia* fee is due on the date specified by the University and is subject to the late registration fee if not paid by that date. The fee is \$96 for 1 unit per semester.

Students passing the preliminary examination may obtain a reduction in their registration and tuition fee at any time during the five-week period beginning on registration day. No other refund in fee may be obtained. A reduction in registration may be made due to changes in departmental service requirements of assistants provided it is made during the two weeks of classes and is approved by the Dean. Any fee reduction for this reason is credited to future registration fees. In the event of death or involuntary call to active duty, refunds will be made on a pro-rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition and room and board charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before classes begin: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

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\*The figures contained in this section are based on 1975-1976 charges and are subject to change prior to the beginning of the fall, 1976, semester.



Fees incurred in connection with thesis or dissertation are as follows:

*Binding fee, three copies of thesis or dissertation, other copies optional, \$5.50 per copy .....	\$16.50
Microfilming fee, doctoral degree only, upon final submission ...	\$30.00
Copyright fee (doctoral degree only, optional) .....	\$15.00
An athletic fee of \$25 for the year is optional and payable in the fall semester.	

The Treasurer of the University has sole responsibility for collection of fees and for arranging for the proration of fees.

**Special Tuition Rates for Teachers and Others.** The Graduate School recognizes a special obligation to encourage the following types of students in their professional and personal advancement: (1) members of the faculties and administrations of the neighboring public schools and colleges, currently engaged in *full-time* school work while taking courses in the Graduate School, (2) ministers of neighboring churches, (3) spouses of Duke faculty members, (4) *full-time* employees of Duke University who are paid on a biweekly or monthly basis *throughout* the year and have been employed for one year. The reduced tuition rates specified below do not apply to teachers and ministers while on leave of absence, or to holders of fellowships, scholarships, or graduate and research assistantships, or to part-time instructors. Persons working toward a degree cannot hold a faculty rank above that of instructor.

Persons eligible for the reduced tuition rate must meet the admission standards required of all graduate students and must be admitted to the Graduate School. They may enroll for one or two courses per semester (in no case totalling more than 7 units) upon payment of a fee of \$5 for registration for each semester and tuition of \$48 per unit of credit or an audit fee of \$20 per course. Residence requirements cannot be fulfilled at the reduced rate. Students enrolled in doctoral programs are not eligible for the reduced rate.

**Fees for Undergraduate Courses.** Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

**Audit Fee.** Any registered student may audit without charge up to three courses per semester if he is registered for at least 15 units, or up to two courses per semester if he is registered for at least 9 units. Otherwise an audit fee of \$40 per course is charged.

**Vehicle Fee.** Each student possessing or maintaining a motor vehicle at Duke University shall register it at the beginning of the academic year in the Security Office at 2010 Campus Drive. If a student acquires a motor vehicle and maintains it at Duke University after academic registration, he must register it within five (5) calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$20 for each motor vehicle or \$10 for each two-wheeled motor vehicle. Resident students first registering after January 1 are required to pay \$14 for a motor vehicle or \$7 for a two-wheeled motor vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate, valid driver's license, and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and \$20,000 per accident for personal injuries, and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

If a motor vehicle or a two-wheeled motor vehicle is removed from the

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\*If more than one snap binder is required per copy of the dissertation, a deposit of \$3.50 will be collected for each additional snap binder.



campus permanently and the decal is returned to the Traffic Office prior to January 1, there will be a refund of \$10 for a motor vehicle and \$5 for a two-wheeled motor vehicle.

**Transcript Fee.** A student who wishes to obtain copies of his academic record should direct requests to the Registrar's Office. A minimum fee of \$2, payable in advance, is charged for a single copy. Where two or more copies are forwarded to a single address, a charge of fifty cents will be made for the second and succeeding copies.

**Debts.** No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.

## Expenses\*

**Housing Fee.** The charge for each person in a double room for the academic year is \$460 in the Graduate Center. The fee for Town House Apartments, not including utilities, is \$692 each for the academic year on the basis of three students to an apartment. Fees for single students and rental rates for married students in Central Campus Apartments will be quoted by the Manager of Apartments and Property.

Housing fees are subject to change prior to the 1976-1977 academic year. A \$50 deposit is required on all reservations. No refund on housing fees is made to students who withdraw after the date of registration, except for those who involuntarily withdraw because of a call to active duty in the armed forces. Such refund will be made in accordance with the University's established schedules. For further information on housing facilities, see Living Accommodations in the chapter on Student Life.

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\*The figures contained in this section are subject to change prior to the beginning of the fall, 1976, semester.



**Food.** Food service, on both the East Campus and the West Campus, is described under Living Accommodations in the chapter on Student Life. The cost of meals approximates \$830 to \$935 per year, depending upon the needs and tastes of the individual.

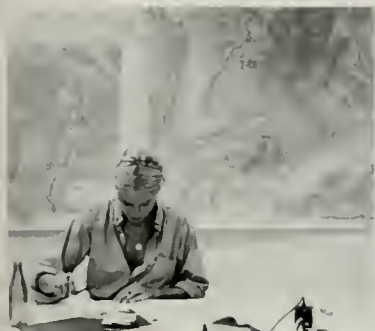
**Summary.** The following table represents an estimate of a graduate student's basic expenses for one academic year for a full program of work. These figures do not include allowances for recreation, travel, clothing, and other miscellaneous items which vary according to personal needs and tastes.

Tuition .....	\$2,880.00
Room Rent (Graduate Center) .....	460.00
Board .....	830.00
Laundry .....	60.00
Books .....	200.00

## Fellowships and Scholarships

**James B. Duke Fellowships.** The James B. Duke One-Hundredth Anniversary Fund provides fellowships for students who wish to pursue a program leading to the Ph.D. degree in the Graduate School at Duke University. Its objective is to aid in attracting and developing outstanding scholars at Duke. Selection is made by a faculty committee upon nomination by the student's department. It is expected that approximately forty offers of this fellowship will be made for the coming year. These fellowships provide for payment of tuition for full registration during the academic year plus *in residence* registration during the summer sessions. They also provide an income stipend of \$325 per month for twelve months over the three year duration of the award. The award requires no service and is renewable each year upon satisfactory progress toward the degree at a fellowship level of quality. The total value of a James B. Duke Fellowship over the full three years of tenure for a beginning student who passes the preliminary examination is \$18,294 at current tuition rates. There are forty-seven James B. Duke Fellows currently enrolled.

**Endowed Fellowships.** Other special endowments provide fellowships for graduate study. The Angier B. Duke Fellowship provides support at the same level as the James B. Duke Fellowship for one student for the academic year. There are six Gurney Harris Kearns Fellowships in Religion ranging in value up to \$4,500. Selection for these fellowships is made through faculty committees. The E. Bayard Halsted Fellowship in science, history, or journalism is awarded to a graduate of Duke University intending to pursue an advanced degree at Duke. This fellowship, which is administered by the Graduate School, provides a monthly stipend plus tuition to an outstanding graduate student working in a broad area of science, history, or journalism. The Frank T. de Vyver Fellowship, administered by the Department of Economics, is awarded each year to an outstanding student entering the doctoral program in Economics. The Clare Hamilton Memorial Endowed Fellowship, a gift of the Hamilton family in memory of their daughter, is awarded yearly to one or more outstanding students in clinical psychology on the bases of merit and need. The stipend of \$3,000 may be used to defray tuition and/or living expenses while the student is engaged in graduate study. Relatives and friends of the late Professor Charles R. Hauser established the Charles R. Hauser Fellowship to be awarded an outstanding graduate student in the last year of work toward a Ph.D. degree in Chemistry. The Department of Chemistry administers this fellowship which is awarded to a student working in the area of organic chemistry. The Calvin



Bryce Hoover Fellowship established in honor of the late Professor Calvin B. Hoover is administered by the Department of Economics. This endowed fellowship is awarded each year to an outstanding student entering the doctoral program in Economics. The Robert R. Wilson Fellowship in the Department of Political Science is awarded to a new student or returning student in a doctoral program in international law, international organization, or international relations. This endowed fellowship is administered by the Department of Political Science. The Gertrude Weil Fellowship, administered by the Department of Religion is awarded students interested in Judaic Studies.

**Graduate Fellowships.** Graduate Fellowships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Stipends, which include tuition, range from \$3,000 for the academic year to \$6,600 for a full calendar year. In 1975-76, there were eighty students holding these fellowships.

**Federal Fellowships.\*** Duke University participates in the following programs:

*National Defense Education Act, Title VI Fellowships.* The purpose of this program is to encourage persons to undertake advanced training in modern foreign languages and in related area studies not commonly taught in the United States. The world area in which National Defense Foreign Language (NDFL) Fellowships are offered at Duke University is Southern Asia. Fellows

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\*United States citizenship is generally a requirement for eligibility.



must engage in intensive study in a language of that world area during their tenure, as well as pursue work toward their degree. The fellowships carry academic-year stipends of \$2,000, \$2,200, or \$2,400, depending on the stage of graduate study, plus tuition and allowances of \$500 for each eligible dependent. In 1975-76, four students at Duke University held NDFL Fellowships. Interested persons should contact the International Studies Center.

*National Science Foundation Fellowships.* A number of students hold National Science Foundation Graduate Fellowships which provide tuition and an income stipend of \$3,900.

Other federal programs support fellowships, traineeships, and research assistantships through departmental auspices. Approximately 475 students were supported through these programs during 1975.

**Canadian Studies Fellowships.** These fellowships are financed by the Donner Foundation for American citizens or permanent residents in the United States who take graduate courses or do research in Canada. The awards are for one year, and the stipends vary from year to year. The award for a nine-month academic year is usually \$300 per month plus tuition at the rate for students who have passed the preliminary examination. Teaching assistantships are financed by the Office of Education, Department of Health, Education and Welfare. They may be held by American residents or, in certain circumstances, by Canadian citizens. The remuneration is \$475 per month for nine months, less tuition fees. Further information can be obtained from the Director of Canadian Studies, Center for International Studies, 2101 Campus Drive, Durham, North Carolina 27706.

**Fellowships in Medieval and Renaissance Studies.** Three fellowships are awarded annually by the Duke University Committee on Medieval and Renaissance Studies. Fellows are chosen from among students engaged in Ph.D. programs and receive full tuition plus a monthly stipend of \$250 for nine months. They may request two renewals of their appointment.

**Special Fellowships.** The following special fellowships are available to qualified Duke students from sources outside the University:

*Shell Fellowships in African Studies.* These are available to qualified students in social sciences who are preparing for careers in the State Department, including the foreign services of the United States, the United Nations, or other international agencies, or in research and teaching in international affairs in academic institutions within the United States. They must be citizens of the United States or, at present, residing permanently in the United States and intending to become citizens. The fellowships are intended to cover the expenses of field research in the preparation of doctoral dissertations. The stipend for each fellowship is \$4,000 plus a reasonable amount for transportation expenses. Inquiries should be made to the Administrative Assistant, Center for International Studies, 2101 Campus Drive, Durham, North Carolina 27706.

*Cokesbury Graduate Awards in College Teaching.* These awards are sponsored by the Board of Education of the Methodist Church. They are designed to assist graduate students who are committed to a Christian philosophy of higher education, who intend to teach in college, and who have been a member of the Methodist Church for at least three years. Awards are for one year and vary in amount from \$500 to \$2,500. Applications must be completed before February 1. Further information and application forms may be obtained from the Dean of the Graduate School.

*Exchange Fellowships with the Free University of Berlin.* These fellowships are available through an exchange arrangement with the Free University of



Berlin which will provide fellowships for two graduate students to study during the regular academic year in Berlin. Departments submit nominations to the Dean of the Graduate School prior to February 1.

**Departmental Fellowships.** Various departments and schools in Duke University have fellowships which are available to students pursuing appropriate studies. Departments should be consulted for further information.

**Graduate Scholarships.** Graduate Scholarships funded by Duke University are available to students in the departments of the Graduate School for study during the academic year. Awards are for full or partial payment of tuition and range in value to \$2,880. In 1975-76, sixty-eight students held Graduate Scholarships.



**Summer Scholarships.** A small number of Summer Scholarships which provide a payment of \$400 are available to students engaged in full-time study during the summer session. Interested students should consult their director of graduate studies.

## Assistantships

**Graduate Assistantships.** Appointments as graduate assistants carry a total stipend up to \$4,800 for the academic year. The value of the stipend is determined by the time given to assisting, the qualifications of the assistant, and the nature of the work assigned. In 1975-76, 176 students held Graduate Assistantships.

**Research Assistantships.** Appointments are for predoctoral candidates whose special training and qualifications enable them to serve as assistants to individual staff members in certain departments. Stipends may be up to \$4,800 depending on the nature of the assistance and the assisting time required. In 1975-76, 179 students held Research Assistantships.

**Part-time Instruction.** Several departments offering graduate work make use of exceptionally qualified graduate students as part-time instructors, tutors, and teaching assistants. These students are usually able to register for a graduate program of 9 units a semester.

## Payment of Awards

The payment of income stipends to graduate students holding awards starts on September 30 and is made in nine equal monthly payments on the last working day of each month thereafter. Research assistants being paid from funds through federal grants and contracts are paid on the twenty-fifth of each month. The Controller of the University has sole responsibility for paying all stipends to students.

Ordinarily stipends awarded under fellowships, scholarships, and research assistantships are not subject to income and Social Security tax. However, a portion of the award to graduate assistants having teaching assignments may be subject to both. The Graduate School Office will supply detailed information.



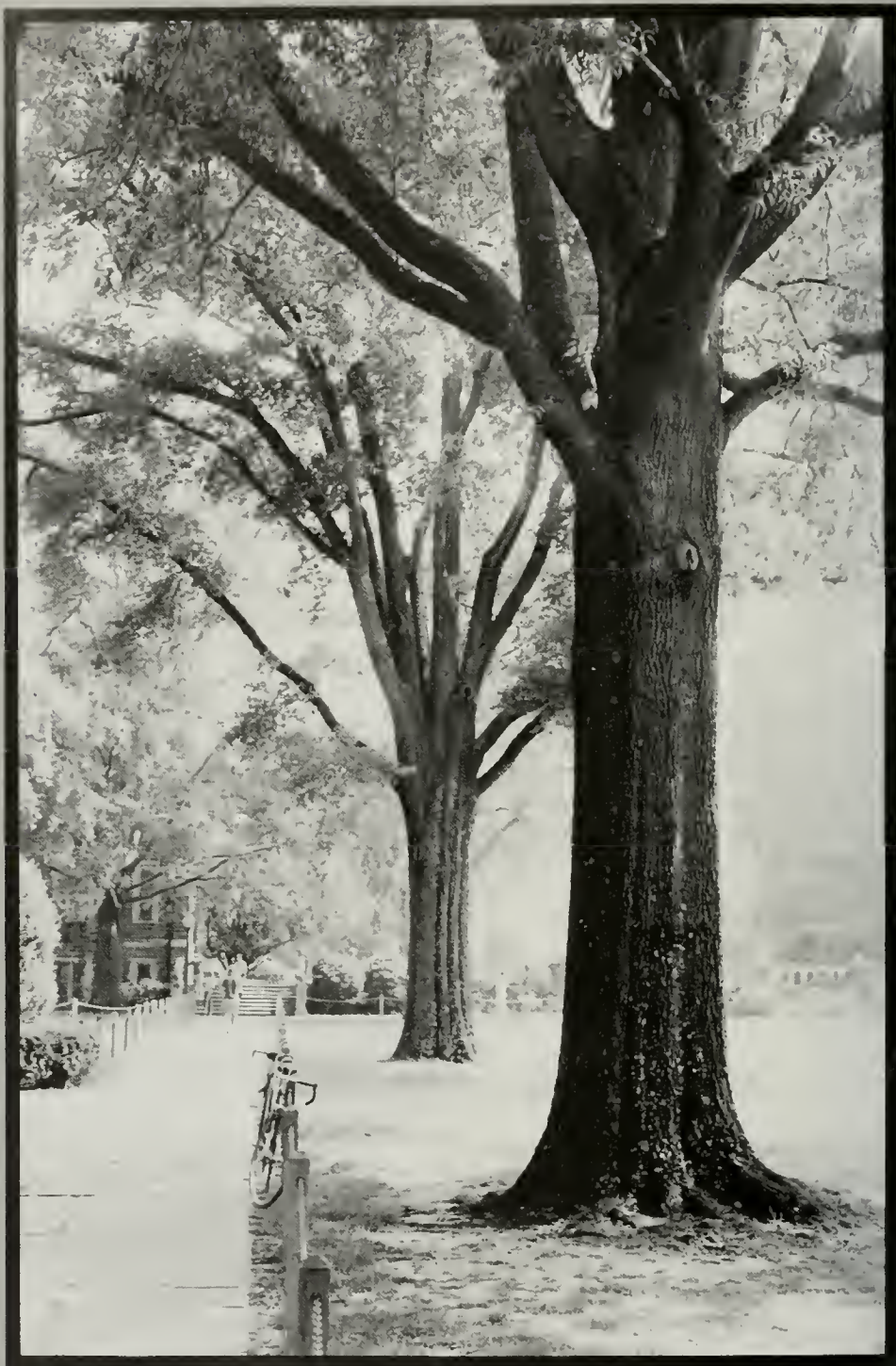
## Loans

It is the policy of Duke University to provide loans when needed to help students meet their educational expenses. Only students with full-time status who can demonstrate need according to established guidelines are eligible for loans. Loan funds are provided through the Federal Insured Student Loan Program, the National Direct Student Loan Program, and funds solely under institutional control. Generally, loans made from these funds bear no interest charge to qualified borrowers while they maintain student status and for a short period thereafter. Interest during the repayment period is at a generally favorable rate. Any student wishing to apply for a loan must, as a first step, complete the student section of a Graduate and Professional School Financial Aid Statement (GAPSFAS) form. If this form has been completed in connection with a loan application to another institution, the student may request that a copy of the analysis be sent to the Graduate School instead of again completing the form. An analysis of financial need will be made on the basis of the information from the GAPSFAS form. Additional information may be required of students who do not qualify as financially independent of their parents. GAPSFAS and other forms which accompany loan applications may be obtained on request from the Graduate School Office. Loan applications should be made prior to July 1 for the subsequent academic year.

## Work-Study Program Employment

Limited funds are available through the College Work-Study Program for short-term or part-time employment of graduate students. Eligibility requirements are similar to those of the federal loan programs. These funds are also used in conjunction with the Graduate School Research Technician Program which provides over fifty students each summer with employment for four weeks doing research in their own specialized area. In addition to this program and to departmental employment opportunities, the Placement Office maintains a listing of employment openings for students.





## Registration and Regulations





## Registration

**Who Must Register.** All students who are enrolled in the Graduate School in any program and who have not been granted a leave of absence by the Dean must register each semester until all degree requirements are completed.

**Registration Periods.** After receiving notification of admission to the Graduate School and returning a statement of acceptance of admission, the student must register for the term indicated in the admission letter. He first confers with the director of graduate studies of his major department who prepares and signs a course card listing the course work to be taken during the semester. The student then presents this course card to registration officials for enrollment in the selected courses. After a student's first registration he must register for subsequent semesters at the regular stated time for registration. Currently enrolled students who fail to register at the first scheduled registration period for the subsequent semester incur a penalty for late registration. *Former students* who intend to register to resume a degree program must give the department and the Dean notice of this intention two months before registration.

**Late Registration.** All students are expected to register at the times specified by the University. A late registration fee of \$25 is charged any student registering late, including a current student who delays registering until the special registration for new students.

**Change of Registration.** During the first *two weeks* of the semester, registration may be changed with the approval of the director of graduate studies if no reduction in fee is entailed. If fees are to be refunded, the approval of the Dean of the Graduate School is required. For the succeeding two weeks, courses may be dropped and equivalent hours of research or residence credit added with the approval of the director of graduate studies, the instructor of the course, and the Dean. Students who pass the preliminary examination during the first five weeks of a semester may alter their registration with fee adjustments at any time during that period.

## Academic Regulations

**Residence.\*** Although graduate study consists principally of individual reading, research, and laboratory experimentation under guidance, academic

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\*See also section on Program Information.

progress in the United States is generally measured and recorded in terms of course hours and credits. Credit for courses and seminars, research, and residence, and corresponding tuition and fees are stated in terms of units. One unit is equivalent to one semester hour. The term *residence* designates full-time study and research in close proximity to the facilities provided, as opposed to part-time study incidental to a full-time occupation. For purposes of satisfying the residence requirement of the various degrees, residence of one year is defined as two successive academic semesters of no less than 9 units registration each semester. (See chapter on Graduate Study in the Summer Session for residence required of master's candidates engaged solely in summer study.) Each student must register for a full program until he passes the preliminary examination.

**Faculty Ruling.** No member of the instructional staff who is a candidate for a degree in the Graduate School of Duke University can hold a faculty rank above that of instructor.

**Course Load.** A graduate student is considered fully registered when he enrolls for the number of credits his program requires. Required registration is set in consideration of the student's obligation to teach or assist and the stage he has reached in fulfilling his degree requirements. In the academic year normal registration for the *resident doctoral* student who does not hold an appointment as part-time instructor or assistant or does not engage in part-time work is 15 units a semester or 30 units an academic year. The registration for the *resident doctoral* student who holds such an appointment or undertakes such work is either 12 units or a minimum of 9 units, depending upon the number of hours a week he is required to devote to such duties. The resident doctoral student carries full registration through the semester in which he passes the preliminary examination. If he remains in residence, he continues to register for a minimum of 3 units each semester until the dissertation is accepted. If he elects to go out of residence (away from the University), he registers for 1 unit each semester *in absentia* in order to keep his program active.

The registration requirements for a resident student pursuing a master's degree are the same as the requirements for students pursuing the doctorate. Once the student has completed all requirements except the thesis, he may reduce his registration to the 3 units per semester, *provided he has not matriculated in a doctoral program at Duke*. If he decides to go out of residence (away from the University), he registers for 1 unit *in absentia*. Regulations pertaining to a resident student engaged in a master's program requiring no thesis are identical to those described above for the doctoral student up to and including the semester in which his course requirements are satisfied. At that point, he may reduce his registration to the number of hours necessary for completion of his degree program.

In each term of the summer session 6 units is maximum registration. Students who are in residence during the academic year and wish to continue study and to use University facilities including the Student Health Service during the summer must register for 1 unit in the first summer session term. This registration provides use of facilities for three terms of the summer session.

The registration of 1 unit a semester *in absentia* provides occasional consultation with the thesis or dissertation supervisor. It may be waived for military duty or serious problems of health.

It is necessary to be a fully registered student according to the regulations listed above in order to establish eligibility for library carrel and laboratory space, student housing, University and some outside loans, and the Student Health Service, including accident and sickness insurance. (See section on Student Life.)

**Credits.** The following regulations pertain to credits earned outside of the Duke University Graduate School:

*Graduate Credit Earned before the A.B. Degree is Granted.* Ordinarily no credit will be allowed for graduate courses taken before a student has been awarded his A.B. or B.S. degree. However, an undergraduate student at Duke University, who at the beginning of his final semester lacks no more than 9 semester hours of fulfilling the requirements for the A.B. or B.S. degree, may obtain permission from the Dean of the Graduate School to enroll for graduate courses to bring his total program to 15 hours a week. Such graduate courses may be credited toward the A.M., M.S., M.H.A., M.Ed., or M.A.T. degree provided that the student meets the requirements for admission to the Graduate School, and that he is duly registered in the Graduate School at the beginning of the semester in which he intends to earn graduate credit.

*Transfer of Graduate Credits.* Transfer of credit for graduate course work completed at another institution will be considered only after a student has earned a minimum of 12 units of graduate study at Duke University. After completing the 12 units, the student should file a request for transfer of credits on the appropriate graduate school form.

*Graduate Credit for Courses Taken in the School of Law.* Upon recommendation of the director of graduate studies, and approval of the Dean of the Graduate School, students in the social sciences may take certain courses in the School of Law for graduate credit. In some instances courses in the School of Law may be considered as fulfilling a student's requirement for related work. To register for such courses, the student should present a letter from his director of graduate studies to the Dean of the School of Law requesting permission to register for specific courses.

**Reciprocal Agreements with Neighboring Universities.** Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina Central University in Durham, and North Carolina State University at Raleigh, students properly enrolled in the Graduate School of Duke University during the regular academic year, and paying full fees to this institution, may be admitted to a maximum of two courses per semester at one of the institutions in the cooperative plan. Under the same arrangement, students in the graduate schools in the neighboring institutions may be admitted to course work at Duke University. All interinstitutional registrations involving extra-fee courses or special fees required of all students will be made at the expense of the student and will not be considered a part of the Duke University tuition coverage.

**Identification Cards.** Graduate students are issued two-part identification cards which they should carry at all times. The cards are the means of identification for library privileges, University health services, athletic events, and other University functions or services open to them as University students. Students will be expected to present their cards on request to any University official or employee.

The cards are not transferrable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of this card immediately to the Registrar's Office. The cost of a new ID card is \$5.

**Grades.** Grades in the Graduate School are as follows: *E*, *G*, *S*, *F*, and *I*. *E* (exceptional) is the highest mark; *G* (good) and *S* (satisfactory) are the remaining passing marks; *F* (failing) is below passing; and *I* (incomplete) indicates that some portion of the student's work is lacking, *for an acceptable reason*, at the time grades are reported. The instructor who gives an *I* for a course specifies the date

by which the student must have made up the deficiency, in no case more than one calendar year from the date the course ended. If the course is not completed, the grade of *F* is normally entered upon the student's record. The grade of *Z* indicates satisfactory progress at the end of the first semester of a two-semester course. A grade of *F* in a major course normally occasions withdrawal from a degree program not later than the end of the ensuing semester or term; a grade of *F* in any other course occasions academic probation.

**Courses Primarily for Undergraduates.** Students granted provisional admission and others whose preparation is found deficient may on occasion be required, as part of their program, to take undergraduate courses as prerequisites to continued graduate study. Undergraduate courses thus taken and others elected by the student will carry no degree credit.

In exceptional cases, 100-level courses *outside the major department* may be taken for degree credit to a maximum of two one-semester courses or one year course not exceeding a total of 8 units, when approved by the directors of graduate studies in the major department and in the department in which the course is listed, and by the supervisor of the program. In order to receive credit for any such undergraduate work, the graduate student must earn a grade of at least *B*. Graduate students registering for undergraduate courses will be assessed 3 units for a non-laboratory course and 4 units for a laboratory course.

**Withdrawal from a Course.** For permissible changes during the first four weeks of a semester, see Change of Registration. If a course is dropped without the necessary approval, the permanent record will list the course as *Dropped Unofficially, F*. If a course is dropped after the four-week period, status of the student at the time of withdrawal from the course will be determined and indicated on the permanent record as *Withdrew Passing (WP)* or *Withdrew Failing (WF)*.

**Interruption of Program and Withdrawal from the Graduate School.** The University reserves the right, and matriculation by the student is a concession of this right, to request the withdrawal of any student whose academic performance at any time is not satisfactory to the University. If a student wishes for any reason to withdraw from the Graduate School, he should notify in writing both the director of graduate studies in his major department and the Dean of the Graduate school prior to the date of his expected withdrawal. (For refunds upon withdrawal, see the section on Tuition and Fees.)

A student who, after successfully completing a minimum of one semester's graduate study, must withdraw before the completion of a graduate program may, with the approval of his major department, request the Dean to issue him a Certificate of Graduate Study.

**Leave of Absence.** A leave of absence for a period of time no longer than one calendar year may be granted because of: (1) medical necessity; (2) full-time employment at Duke University; or (3) acceptance of an external award judged likely to benefit the student as an individual but not related to the student's degree requirements. The request for leave of absence should be originated by the student, endorsed by his major professor and the director of graduate studies in his department, and submitted to the Dean of the Graduate School for consideration. A student is eligible to request a leave of absence only after he has completed at least one semester at Duke. Time limitations which pertain to the various degrees and the completion of courses on which a grade of *I* (incomplete) was earned are not waived.

**Size and Make-up of Classes.** Classes which carry graduate credit are limited in size to thirty students. In exceptional cases this regulation may be modified,





but only by permission of the Dean of the Graduate School. Courses numbered from 200 through 299 may have not only graduate students enrolled but also an unspecified number of sophomores, juniors, and seniors, provided the undergraduates have the approval of both the course instructor and the director of graduate studies. Undergraduate students are not permitted to enroll in 300-level courses.

**Language Requirements.** Although individual departments have the right to establish their own minimal requirements (see individual departmental sections in this *Bulletin*), the regulations of the Graduate School require no language for the master's degree, and, in most departments, a reading knowledge of one foreign language, ancient or modern, for the Ph.D. degree. With the special approval of the Dean and of the Executive Committee of the Graduate Faculty, the foreign language requirement for the Ph.D. degree may be waived in individual cases or with respect to all students in a given department, provided the department submits satisfactory evidence that a foreign language has little bearing on the major program of the students concerned. The languages usually taken are French, German, and Russian. A student may substitute for any one of these another language which has a definite relation to his



degree program and for which an examination can be provided. A foreign student whose native language is not English may request that the director of graduate studies in his department ask permission of the Dean of the Graduate School to offer English for the foreign language required in his program.

To avoid unnecessary delays, prospective students should anticipate the language requirement of their degree programs. For example, students whose programs call for a knowledge of French, German, Russian, or Spanish are urged to take the appropriate Educational Testing Service (ETS) Graduate School Foreign Language Test prior to registration. It should be noted, however, that at the time of the final examination in a master's program or of the preliminary examination in a doctoral program, language examinations more than six calendar years old will not be accepted toward fulfilling the language requirement.

*Meeting the Requirement.* The foreign language requirement may be satisfied in the following ways:

1. The student may take one of the ETS examinations administered to undergraduate and graduate students at many national centers (including the Duke University Counseling Center). The examination may be taken no longer than six years before the preliminary examination.

2. With the permission of the Dean of the Graduate School, the director of graduate studies may request transfer acceptance of a language examination passed prior to the student's enrollment at Duke. The student should request that a transcript or other certification that the language was passed be sent to the Graduate School for approval. Requirements are (a) that only one language of a doctoral requirement may be met in this way, (b) that the other institution offers a doctoral program in the student's major and the examination would have met a doctoral requirement there, and (c) that the examination was passed no more than five years before first registration here.

3. In a language for which ETS tests are not available, a reading examination may be arranged by the Graduate School Office and administered by a qualified examiner.



4. In special circumstances, a reading examination in any foreign language may be administered by a qualified member of the faculty under a procedure specified by a department and approved by the Dean and the Executive Committee of the Graduate Faculty.

*Requirements for Foreign Students.* Foreign students whose native language is not English are, during their first registration period, required to take a test for minimum competence in English. Such students with the approval of the director of graduate studies in their major department, may request permission of the Dean of the Graduate School to substitute English for the one foreign language required in the master's or doctoral program. (See Admission Procedure for Foreign Students.)

**Special Reading Courses.** Special courses designed to assist graduate students in acquiring a reading knowledge of French or German are offered for three hours a week: French during the fall semester and occasionally in the spring semester, German during the spring semester and the summer session. A student who registers for either course must reduce his normal load of graduate courses by 3 units, with no reduction in fees. No auditors are permitted in these courses. Undergraduates may not enroll in these special courses during the academic year but may register in the summer with permission of the Dean of the Graduate School, provided space is available after graduate students have been enrolled.

**Undergraduate Language Courses.** Graduate students receive no credit for language courses numbered below 200.

## Commencement

At commencement exercises in May, degrees are awarded to students who have completed all degree requirements by the end of either of the two regular semesters of the academic year. Students who complete all degree requirements by the end of a summer term become eligible to receive diplomas dated September 1. No commencement exercises are held for the awarding of September degrees, and diplomas are mailed after final approval by the Academic Council and Trustees of the University.

## Standards of Conduct

Duke University expects and will require of all its students cooperation in developing and maintaining high standards of scholarship and conduct.

The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University currently in effect or which, from time to time, are put into effect by the appropriate authorities of the University.

**Judicial Code and Procedures.** In the spring of 1971, the Graduate School community ratified and adopted the following official judicial code and procedures:

### I. Graduate School Judicial Code and Procedures

- A. A student, by accepting admission to the Graduate School of Duke University, thereby indicates his willingness to subscribe to and be governed by the rules and regulations of the University as currently in effect or from time to time put into effect by the appropriate authorities of the University, and he indicates his willingness to accept disciplinary action, if his behavior is adjudged to be in violation of those rules or in some way unacceptable or detrimental to the University. However, a student's position of responsibility to the authorities and the regulations of the University in no way alters or modifies the responsibilities that are his in relation to civil authorities and laws.

- B. A graduate student at Duke University stands in a primary and unique relation of responsibility to the faculty in his major department, the faculty upon whose recommendation a graduate degree will or will not be awarded to the student. In matters which involve or may affect the student's intellectual or professional life, the student is directly responsible to this department and its representatives, and such matters should primarily be handled by the department.
- C. Actions which appear to conflict with University-wide rules and regulations will fall under jurisdiction of the University Judicial Board.
- D. A student may elect to have the Dean of the Graduate School hear matters related to the student's conduct in addition to or instead of faculty members from the student's major department, or he may elect to have such matters reviewed and judged by a judicial board instead of the Dean of the Graduate School or members of the faculty in his major department. (The constitution and procedure of the judicial board are detailed below).
- E. The Director of Graduate Studies in the student's major department may request that a student's actions be reviewed by the Judicial Board or by the Dean of the Graduate School.

## II. The Graduate School Judicial Board

- A. *Composition.* The Graduate School Judicial Board shall have five members, serving for a period of two years: two students selected from the student body, two members of the Graduate Faculty appointed by the Executive Committee of the Graduate School, and one Associate or Assistant Dean appointed by the Dean of the Graduate School. The Board shall elect one of its members as Chairman. The Board shall have at its service a recording secretary to keep minutes of the hearings and of the Board's actions in a permanent, confidential record book. The Board will be constituted in order to hear cases in which the accused is a student currently enrolled in the Graduate School and which have been referred to it by the Director of Graduate Studies in the student's department, by the Dean of the Graduate School, or by the student himself.
- B. *Preliminary Procedures.* If a student requests a hearing by the Judicial Board he must do so in writing, allowing its chairman at least 72 hours to convene the Board. In addition, the chairman shall not convene the Board until 72 hours after he had been asked to convene the Board.

It is the responsibility of the Chairman of the Judicial Board fully to inform its members concerning the case and the reasons the case has been referred to the Board. In addition, he shall prepare a written summary of this information for the Board, the Dean, and the student.

- C. *Procedural Safeguards for the Hearing.* The Accused has the right to challenge any member of the Judicial Board on grounds of prejudice. If the Board decides to excuse one or more of its members for reasons given by the Accused, it shall consult with the Dean about the need for replacements.

The Accused may choose an Advisor to assist him in his defense. He may also produce witnesses (including no more than two character witnesses) introduce documents, and offer testimony in his own behalf.

A person having direct knowledge relevant to a case being heard by the Board is a material witness. The Judicial Board may request the appearance of material witnesses. The Board shall also request, upon written request of the Complainant or the Accused, the appearance of material witnesses. Witnesses shall be notified of the time, place, and purpose of their appearance.

The Accused has the right to examine the written statement of any witness relevant to his case at least 72 hours before the hearing. He has the right to be faced with any witnesses who has given a statement relevant to his case at the hearing if the witness's attendance can be secured.

The hearing will be conducted in private unless the Accused requests an open hearing. If any objection is raised to conducting an open hearing in any particular case, the Judicial Board shall decide the issue by majority vote. If the decision is made not to hold an open hearing, the Accused shall be informed in writing of the reasons for the decision.

The Judicial Board shall consider only the report of the Chairman, documents submitted into evidence, and the testimony of witnesses at the hearing in reaching its decisions.

- D. *Conduct of the Hearing.* The hearing of any case shall begin with a reading of the charge by the Chairman in the presence of the Accused. The Accused shall then plead guilty or not guilty or move to terminate or postpone the hearing. The Accused may qualify a plea, admitting guilt in part and denying it in part.

The Accused may not be questioned for more than one hour without recess.

At any time during the hearing, the Accused or the Judicial Board may move to terminate or to postpone the hearing or to qualify his plea or to modify its charge.

Pending verdict on charges (including appeal) against the Accused, his status as a student shall not be changed, nor his right to be on campus or to attend classes sus-



pended, except that the Chancellor or Provost may impose an interim suspension upon any member of the University community who demonstrates, by his conduct, that his continued presence on the campus constitutes an immediate threat to the physical well-being or property of members of the University community or the property or orderly functioning of the University.

- E. *Sanctions and the Verdict.* The Graduate School Judicial Board shall have the power to impose the following penalties: expulsion, dismissal from the University with the recommendation that the person never be readmitted; Suspension, dismissal from the University and from participation in all University activities for a specified period of time, after which the student may apply for readmission; Disciplinary Probation, placing the student on a probationary status for a specified period of time, during which conviction for violation of any regulation may result in more serious disciplinary action; Restitution, payment for all, or a portion of property damage caused during the commission of an offense. Restitution may be imposed by itself or in addition to any of the other penalties.

The Judgment shall consist of a finding of guilty or not guilty of the charge and, when the Accused is found guilty, a statement of the punishment assessed. On all questions, including the verdict and the finding of guilty or not guilty, the Board shall be governed by a majority vote.

The Judicial Board may decide to rehear a case in which significant new evidence can be introduced. In addition, the defendant may request an appeal.

- F. *Appeals.* The appellant may submit to the Dean a written statement containing the grounds for his appeal and his arguments. In such cases, the Dean should determine if the appeal should be granted, and he can hear the case himself, or refer it to the appropriate faculty in the student's department or to the Judicial Board.

An appeal shall be granted on the following grounds: procedural error substantially affecting the rights of the accused; incompatibility of the verdict with the evidence; excessive penalty not in accord with "current community standards"; new evidence of a character directly to affect the judgment but on which the original tribunal had refused a new hearing.

### III. Amendment and Construction

This Judicial Code and Procedure and this constitution and procedure for the Graduate School Judicial Board may be amended at any time with due notice or publication by consent of the Dean, the Executive Committee, and the graduate students. Questions and problems not answered or anticipated by the foregoing may be resolved by the use of other existing institutions or by amendment.



Study in the Summer



## Programs Offered

The 1976 Summer Session of Duke University will consist of three terms. The first term will begin on May 11 and will end on June 12. The second term will begin on June 14 and will end on July 16. The third term will begin on July 19 and end on August 20.

Graduate students who wish to work toward advanced degrees in the summer session, particularly in chemistry, economics, education, English, history, mathematics, religion, sociology, and zoology, will find a selection of courses offered by members of the Duke faculty and by visiting professors. Other departments ordinarily offering work leading to the A.M. degree are botany, political science, and psychology. Thesis research for advanced graduate students is available also in most other departments, such as engineering, forestry, and physics.

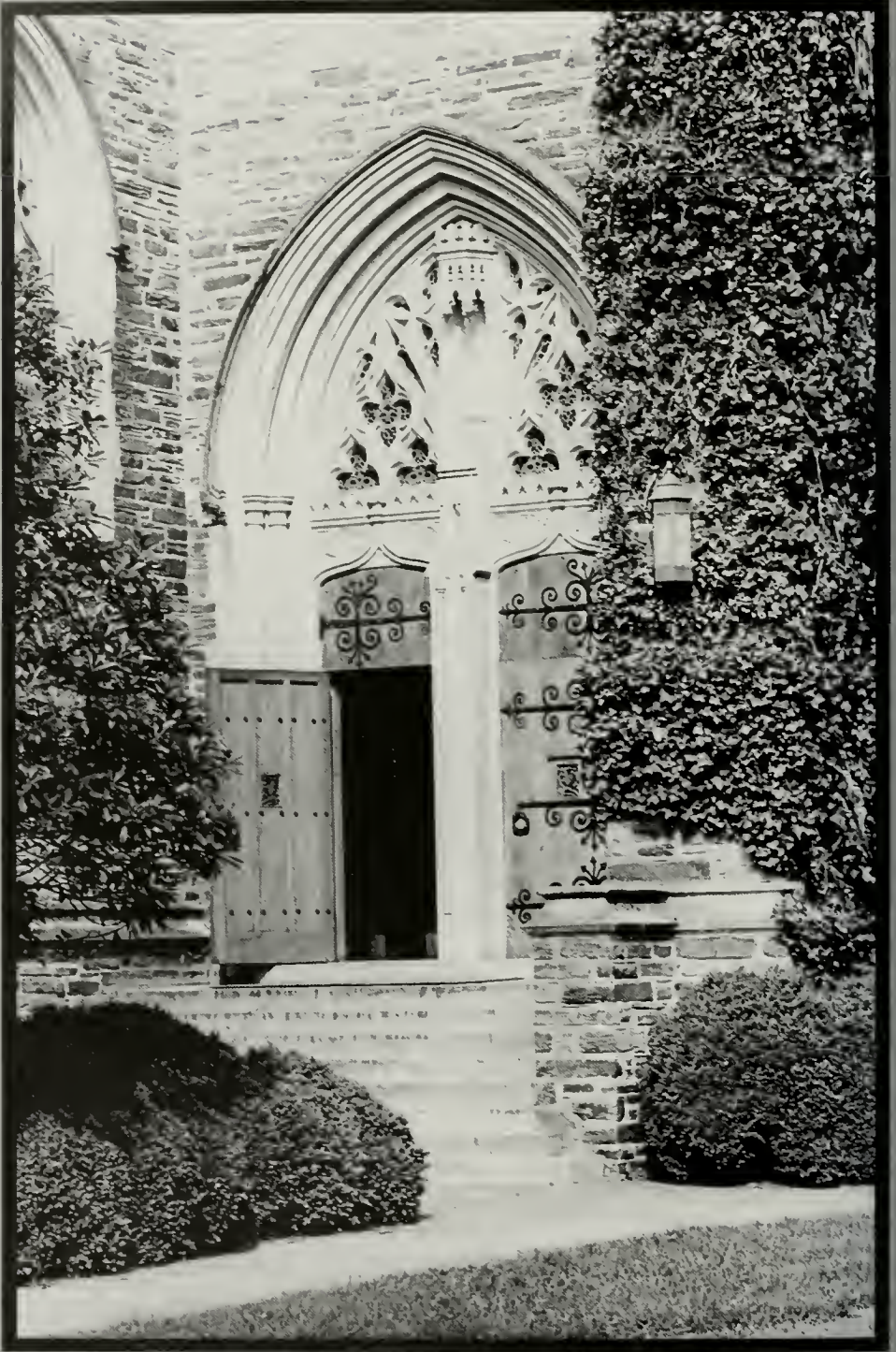
Students who wish to be admitted to the Graduate School for work in the summer session should make application to the Dean of the Graduate School, as well as to the Director of the Summer Session, and should return the completed application, with supporting documents, before April 15 for admission to Term I; before May 15 for admission to Term II; and, before June 15 for admission to Term III. (See the section on Admission.)

## Regulations Regarding Summer Work

No graduate student may register for more than 6 units of credit in one summer session term. All of the work required for the master's degree must be completed within six years of the date of matriculation. No residence credit can be accepted toward the requirement for the Ph.D. degree for work completed during the summer sessions. Students who complete during the summer session the work required by the University for an advanced degree will be granted the degree in September.

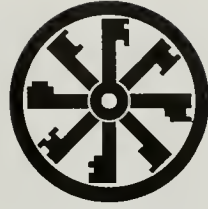
The *Bulletin of the Summer Session*, containing information about graduate courses, may be obtained by writing to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.





## Courses of Instruction





## Course Enrollment

In general, courses with odd numbers are offered in the fall semester, those with even numbers in the spring semester. Double numbers separated by a hyphen indicate that the course is a year course and usually must be continued throughout the year if credit is to be received. A student must secure written consent from the instructor in order to receive credit for either semester of a year course. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special consent. Ordinarily, courses which bear no date are offered every year.

*Note:* In each department the number 399 is reserved to designate special (individual) readings in a specified area and supervised by a regular member of the graduate staff, with credit of one to three units each registration, only one course per registration, and nine units maximum in three successive registrations. The course is restricted to resident master's and doctoral programs, must have a completion exercise, and must carry a grade.

## Anatomy

Professor Robertson, *Chairman* (Room 466, Sands Building); Assistant Professor Adelman, *Director of Graduate Studies* (Room 270, Sands Building); Professors Everett, Moses, and Peele; Associate Professors Cartmill, Counce, Duke, Erickson, Hall, Hylander, Longley, and Reedy; Assistant Professors Blake, Corless, Fletcher, Johnson, Kay, Mahaley, Strickler, and Tyrey; Lecturer Diamond; Adjunct Assistant Professors Bergeron and Carpenter

The Department of Anatomy offers graduate programs designed to produce teachers and research workers competent in a broad range of anatomical sciences; A.M. and Ph.D. degrees are offered. Students with a wide variety of backgrounds and interests in the biological sciences can be accommodated. All students participate in a core of anatomical science courses (Anatomy 305, 307, 309) and gain experience in teaching over the range of departmental interests. Students are encouraged to round out their formal course work by drawing upon the offerings of other departments in the University, as well as those in

the Anatomy Department. Laboratories within the department are equipped for and actively support research in several areas. Some idea of the opportunities for degree research may be gleaned from the description of Anatomy 312. For further information contact the Director of Graduate Studies.

**207. Human Anatomy.** A lecture-laboratory discussion course that examines human morphology and the fundamental relationships among the neurologic, musculo-skeletal, cardiovascular, gastrointestinal, respiratory, renal, and reproductive systems. The course includes cadaveric presentations of every major region of the human body. Intended primarily for students in allied health programs. Prerequisite: consent of instructor. Credit variable; maximum 3 units. *Blake and Kay*

**208. Anatomy of the Trunk.** Designed for Ph.D. candidates in anatomy as well as general practitioners and specialists in surgery and internal medicine. Emphasis upon the anatomy of the thoracic, abdominal, and pelvic organs. Prerequisites: core courses in anatomy. Number of students arranged by staff. 2 units. *Duke*

**212. Cellular Endocrinology.** Relationship between the morphologic and functional characteristics of mammalian endocrine cells; drawing on light and electron microscopic, as well as physiological and biochemical investigations. Topics treated in the context of their relevance to endocrine systems include: physical basis of secretory processes, intercellular junctions and communication, immunocytochemical localization of hormones and receptors, topography of cell surfaces. Students are expected to become familiar with the pertinent literature and to present a brief seminar at the end of the course. Complementary to Anatomy 418. Prerequisite: Anatomy 307 or equivalent, and consent of instructor. Offered spring, 1976 and alternate years thereafter. Enrollment: minimum 5. 3-4 units. *Fletcher*

**215. Contractile Processes.** (Also listed as Physiology 216.) 3 units. *Anderson, Jobsis, Johnson, or Reedy*

**216. Biological Psychology.** (Also listed as Psychology 216.) *Diamond*

**217. Structure and Function of Visual Photoreceptors.** A detailed study of available structural, biochemical, spectroscopic, and physiological data from retinal photoreceptors. Emphasis on molecular structure of vertebrate photoreceptor membranes, effects of bleaching or rhodopsin molecule, and initiation of neural information after photon absorption. Lectures, seminars, and demonstrations. Complements Anatomy 276. Offered fall, 1977, and alternate years thereafter. Prerequisites: Anatomy 276, 280, 286, 290, 301, Zoology 246, physical chemistry, or consent of instructor. Credits to be arranged; maximum 4 units. *Corless*

**219. Molecular and Cellular Basis of Development.** A multidisciplinary approach stressing the molecular, cellular, and genetic processes involved in development and differentiation in pro- and eukaryotes. Topics include: initiation of development, morphogenesis, developmental genetics, differentiation, and nuclear-cytoplasmic interactions in development. (Also listed as Biochemistry 219, Microbiology 219, Pathology 219, and Physiology 230.) 3 units. *Counce, Johnson, Kaufman, McCarty, and Padilla*

**219S. Seminar.** Optional seminar offered in conjunction with Anatomy 219. Students prepare and present seminar topics directly related to specific subjects discussed in Anatomy 219. Prerequisites: enrollment in Anatomy 219 and consent of instructor. 1 unit.

**231. Human Evolution.** Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossil and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. (Also listed as Anthropology 231.) 3 units. *Cartmill*

**238. Function and Evolutionary Morphology of Primates.** History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anatomy 231 (Anthropology 231) or equivalent, or consent of instructor. (Also listed as Anthropology 245.) Offered spring, 1977, and alternate years thereafter. 3 units. *Cartmill or Hylander*

**240. Mechanisms of Biological Motility.** Discussions, based on extensive readings, on the ultrastructure and biochemistry of biological motile systems. Introductory discussions of muscle contraction and sperm-cilia-flagella will form the basis for subsequent consideration of such weekly topics as amoeboid motion, fibroblast motility, protoplasmic streaming, mitosis, particle saltations, etc. Emphasis placed on defining similarities between systems with different phenomenologies of motion. Ends with a series of brief student seminars on topics from areas not covered in the principal seminars. Prerequisite: written consent of instructor. Enrollment: minimum 4; maximum 10. 3 units. *Adelman*

**246. The Primate Fossil Record.** (Also listed as Anthropology 246.) 3 units. *Cartmill and Kay*

**261. History of Generation and Mammalian Reproduction.** Theories of generation and of historical development of present-day concept of mammalian reproductive processes. Prerequisite: consent of instructor. Offered fall, 1977, and alternate years thereafter. (Alternates with Anatomy 263.) 1 unit. *Duke*

**263. History of Anatomy.** The lives and contributions of the founders of anatomy, Aristotle to the twentieth century. Prerequisite: consent of instructor. Offered fall, 1976, and alternate years thereafter. (Alternates with Anatomy 261.) 1 unit. *Duke*

**264. Mammalian Embryology and Developmental Anatomy.** Study of early embryology and organology of mammals, using the rat as the basic form, supplementing it with other mammalian forms, including primates. Prerequisites: one year of zoology and consent of instructor. 4 units. *Duke*

**265. Seminar in Chromosome Biology.** (Also listed as Zoology 265.) 2 units. *Moses and Nicklas (Zoology)*

**266. Seminar in Chromosome Biology.** See course description for Zoology 265. (Also listed as Zoology 266.) *Moses and Nicklas (Zoology)*

**276. Neuroanatomical Basis of Sensory Physiology.** Original papers read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. Prerequisite: consent of instructor. Offered spring, 1977, and alternate years thereafter. (Also listed as Psychology 276.) 3 units. *Hall*

**280. Structure and Assembly of Macromolecules.** Lectures and conferences on the structure of biological macromolecules and on the mechanisms of assembly of organized macromolecular aggregates such as are found in viruses and cellular organelles. Emphasis on the results of electron microscopic, X-ray diffraction, and optical analyses. Prerequisites: microscopic anatomy or cytology, or equivalent, and consent of instructor. Offered spring, 1977, and

alternate years thereafter. (Alternates with Anatomy 286.) 3 units. *Longley, Corless, Erickson, Moses, Reedy, and Robertson*

**286. The Light Microscope, the Electron Microscope, and X-ray Diffraction in Biology.** Lectures and laboratories on methods of ultrastructure research. Fundamentals of optics; the light microscope, phase, polarizing, and interference microscopy. Basics of electron microscopy, staining, sectioning, and replication techniques. Optical and computer image processing. Introduction to X-ray diffraction theory and apparatus in structure determination. Prerequisites: microscopic anatomy or cytology (or equivalent), calculus and one year each of physics and general chemistry; consent of instructor. Offered spring, 1976, and alternate years thereafter. (Alternates with Anatomy 280.) 4 units. *Longley, Corless, Erickson, Moses, Reedy, and Robertson*

**288. Seminar on the Role of the Cell in Development and Heredity.** Topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. Offered spring, 1977 and alternate years thereafter. (Also listed as Zoology 288 and under the University Program in Genetics.) 2 units. *Counce*

**291. Special Topics in Nerve Ultrastructure.** Each student chooses a topic, such as ultrastructure of synapses, or sensory nerve endings including the retina, or auditory nerve, or simple nerve nets, or morphological correlates of learning. Each student pursues his topic in the library during the first half of the semester with guidance from the instructor in order to prepare a detailed paper. The second half of the semester is devoted to seminar presentations and discussions of the selected topics. Enrollment: minimum 5. 2 units. *Robertson*

**300. Gross Anatomy.** Gross anatomy for physical therapy students. Credit to be arranged; maximum, 8 units. *Blake or Kay*

**303. Neuroanatomical Basis of Behavior.** Basic neuroanatomy and its physiologic and functional correlates. 3 units. *Hall and Peele*

**305. Gross Human Anatomy.** Includes complete dissection of a cadaver; laboratory work is supplemented by conferences which place emphasis upon biological and evolutionary aspects. Prerequisites: adequate background in biology, including comparative anatomy and embryology, and written consent of the Director of Graduate Studies. Required of entering graduate students in Anatomy; by arrangement, may extend into second semester. Hours and credit to be arranged. 3 units. *Staff*

**307. Microscopic Anatomy.** Emphasis on the cell, its generalized structural and functional organization down to the molecular level, and differentiations of the cell in various organs and tissues. Introduction to light and electron microscopic and diffraction methods for investigating biological structure. Prerequisites: adequate background in biology, including comparative anatomy and embryology, and written consent of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Hours and credits to be arranged. 3 units. *Staff*

**309. Neuroanatomy.** Gross and basic intrinsic anatomy of the central nervous system. Later, specific systems will be emphasized; various sensory and motor, limbic-hypothalamic, and cerebral-associated mechanisms. Clinical presentations will be offered. Prerequisites: adequate background in biology, including comparative anatomy and embryology, and written consent of the Director of Graduate Studies. Required of entering graduate students in anatomy; by arrangement, may extend into second semester. Hours and credits to be arranged. 2 units. *Staff*



**312. Research.** Individual investigations in the various fields of anatomy. Laboratories in which a student may work include: three electron microscopy laboratories headed by Moses, Reedy, and Robertson with emphasis respectively on the fine structure and cell biology of chromosomes and associated structures, molecular structure and function of muscle, and biophysical studies of cell membranes and nervous tissue; physical anthropology laboratories and the Primate Facility under Bergeron, Cartmill, Hylander, and Kay concentrating on biomechanics, cytogenetics, comparative anatomy, and primate evolution and behavior; neuroanatomy laboratories under Peele, Hall, and Diamond emphasizing structural correlates of behavior and learning; cell biology and neuroendocrinology laboratories under Everett, Blake, and Fletcher with emphasis on brain mechanisms regulating reproductive functions of the pituitary gland and on intercellular communication in the pituitary and ovary; comparative anatomy laboratory under Duke focusing on ovarian structure and function; a functional vertebrate morphology laboratory under Strickler emphasizing morphology and behavior of bats; developmental biology laboratories under Counce and Johnson with emphasis on insect and amphibian morphogenesis and the role of cell membrane contact phenomena in differentiation; a cell biology laboratory under Adelman studying the biochemistry and phenomenology of primitive motility; and molecular structure laboratories under Longley, Erickson and Corless using a combination of electron microscopy, X-ray diffraction, and optical and computer methods of image analysis to study respectively fibrous proteins, microtubules, and photoreceptor membranes. Credits to be arranged. Consent of staff required. Maximum, 6 units. *Staff*

**313, 314. Anatomy Seminar.** Regular meeting of graduate students and staff in which current research problems in anatomy will be presented. 1 unit per semester. *Staff*

**340. Tutorial in Advanced Anatomy.** Topics for intensive reading and discussion will be chosen according to the student's interests, related to basic problems in biophysics, cytology, endocrinological control, growth and development, neuroanatomy, physical differentiation, and evolutionary origins of functional micro-systems. Enrollment: maximum 8. Prerequisite: consent of instructor. 3 units. *Staff*

**344. Advanced Neuroanatomy of Sensory and Motor Mechanisms.** The course will involve consideration of classic and modern concepts of somatic and special sensory systems and of somatic and visceral motor systems. Clinical correlations of basic neuroanatomy will be included. Enrollment: minimum 5; maximum 20. 3 units. *Peele*

**354. Research Techniques in Anatomy.** A preceptorial course in various research methods in anatomy. An interested student might engage in research in one of the following: anthropology, electron microscopy, X-ray diffraction, chromosome analysis, developmental biology, fetal physiology, primate behavior, primate anatomy, and stereotactic approaches to neuroendocrinology and neuroanatomy. Other topics may be arranged. Prerequisite: consent of instructor. Units to be arranged. *Staff*

**418. Reproductive Biology.** See course description for Physiology 418. (Also listed as Physiology 418.) 2 units. *Anderson, Blake, Everett, Fletcher, Schomberg, and Tyrey*

## Anthropology

Professor Friedl, *Chairman and Director of Graduate Studies* (03 Old AROD

Building); Professors Fox and LaBarre; Associate Professors Apte, Cartmill, Hylander, O'Barr, Rosen, and Smith; Assistant Professors Boon, Casson, Glander, Quinn, and Stack (Public Policy Sciences)

The department offers graduate work leading to the Ph.D. degree in anthropology. Applicants for admission should submit scores on the Graduate Record Examination Aptitude Test.

Candidates for the Ph.D. degree must demonstrate a general competence in four major sub-fields (sociocultural anthropology, physical anthropology, anthropological linguistics, and prehistory) as well as specialization in one or more of these sub-fields. Recognizing a trend in modern anthropology toward interdisciplinary research, the department allows the student to replace some of the course work required for the Ph.D. degree by advanced work in anatomy, economics, psychology, sociology, zoology, or other disciplines relevant to a student's program.

Further details of the graduate program in anthropology, the departmental facilities, the staff, and various stipends available are described in the *Guidelines for Graduate Students in Anthropology* which may be obtained from the Director of Graduate Studies, Department of Anthropology.

### For Seniors and Graduates

**210. Linguistic Anthropology: Theory.** Examination and comparison of predominant schools of language study—comparative-historical, structural, transformational, stratificational, and generative semantics. Prerequisite: Anthropology 107 or consent of instructor. One course. (3 graduate units.) *Apte or Casson*

**211. Linguistic Anthropology: Ethnography of Communication.** Verbal and nonverbal communication from linguistic and anthropological perspectives with emphasis on synchronic and diachronic aspects of communication, development of sociolinguistic theory and its application to intra- and intercultural communicative processes. Prerequisite: Anthropology 107 or consent of instructor. One course. (3 graduate units.) *Apte or Casson*

**220S. Society and Culture in India.** The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course (3 graduate units.) *Apte or Fox*

**222. Topics in African Anthropology.** Research problems illustrated through ethnographic studies of African societies. One course. (3 graduate units.) *O'Barr*

**242. Topics in Prehistory.** Anthropological issues derived from archeological and early historical investigations. Prerequisite: Anthropology 93 and 94 or equivalent. One course. (3 graduate units.) *Staff*

**243. Theory and Method in Archeology.** Techniques of geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses applied to problem areas in archeology—human cultural origins, Paleolithic and post-Pleistocene readaptations, origins of agriculture and civilization. Prerequisite: Anthropology 166 or consent of instructor. One course. (3 graduate units.) *Staff*

**244. Primate Behavior.** Examination of the social behavior of prosimians, monkeys, and apes in an attempt to understand the evolutionary development of the primate order and the origin of man. One course. (3 graduate units.) *Glander*

**245. Functional and Evolutionary Morphology of Primates.** History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anthropology 132 (Anatomy 231) or equivalent, or consent of instructor. (Also listed as Anatomy 238.) One course. (3 graduate units.) *Cartmill or Hylander*

**246. The Primate Fossil Record.** Evolution of man and other primates as inferred from fossil remains. Prerequisite: a course in human evolution or consent of instructor. One course. (3 graduate units.) *Cartmill or Kay*

**249. Topics in Economic Anthropology.** Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *O'Barr, Quinn, or Smith*

**250. The Anthropology of Cities.** Organization and behavior of men in urban centers analyzed from an evolutionary perspective; cross-cultural analysis of cities and their varying roles. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *Fox*

**251. Ethnography of Humor.** Examination of theoretical framework, research methods and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *Apte*

**259. Linguistic Anthropology: Language Acquisition.** Biological basis of human linguistic capacity; major theoretical positions in linguistics; acquisition of semantics, syntax, and phonology in English and other languages. Prerequisite: Anthropology 107 or consent of instructor. One course (3 graduate units.) *Casson*

**264. Primitive Religion.** The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. One course. (3 graduate units.) *LaBarre*

**265. Personality and Society.** The sociology and social psychology of human personality, its origins in the primary group, its nature and varieties, and its integrations into secondary group institutions. One course. (3 graduate units.) *LaBarre*

**266. Personality and Culture.** The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comprehensive anthropological materials will be drawn upon. One course. (3 graduate units.) *LaBarre*

**267. Cognitive Anthropology.** Theoretical and methodological developments in the study of taxonomies, naturally occurring categories, information-processing rules, decisions, and belief systems. Psychological testing of non-Western people; effects of schooling. Prerequisite: Anthropology 94 or 99. One course. (3 graduate units.) *Quinn*

**268. Law and the American Indian.** Survey of the legal status and problems of the contemporary American Indian. Topics include the basis and extent of tribal sovereignty, the relation of states and their Indian citizens, treaties and Indian claims actions the legal context of economic development, and the legal position of Eastern American Indians. One course. (3 graduate units.) *Rosen*

**270. Ethnographic Field Methods.** Research strategies and techniques for



field research; participation in a field project in a local community. One course. (3 graduate units.) *Casson, O'Barr, or Quinn*

**271. Methods of Data Analysis.** Quantitative analysis of anthropological data. One course. (3 graduate units.) *Quinn*

**272. Primitive Music.** A comparative ethnological study of non-western music, emphasizing different scales (mode, raga, magam, lu,) conventions, styles, social functions, and cultural contexts; some attention to the African origins of jazz. Sufficient technical background will be provided for the non-specialists. One course. (3 graduate units.) *LaBarre*

**273. Primitive Art.** A comparative ethnological study of non-European art and artists emphasizing media, conventions, social functions, and cultural contexts. One course. (3 graduate units.) *LaBarre*

**275. Rank, Power, and Authority in Pre-Industrial Societies.** The role and development of social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. Prerequisite: concentration in anthropology or graduate standing. One course. (3 graduate units.) *Fox*

**276. Analysis of Kinship Systems.** Primitive relationship categories as related to legal norms and social groupings. Theoretical issues and contrasting approaches to the analysis of social classification terminologies. One course. (3 graduate units.) *Boon or Casson*

**277. Class, Ethnicity and Public Policy.** (Also listed as Public Policy Sciences 277.) One course. (3 graduate units.) *Stack*

**278S. Special Topics in Political Anthropology.** Current research problems. Topics will change each semester. Prerequisite: Anthropology 134 or consent of instructor. One course. (3 graduate units.) *O'Barr or Quinn*

**280S, 281S. Seminar in Selected Topics.** Special topics in methodology, theory, or area. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Staff*

**291, 292. Anthropological Theory.** Theoretical, methodological, and comparative issues. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Boon, Fox, or Quinn*

## For Graduates

**330, 331. Seminar in Anthropology.** A seminar for advanced students who wish to pursue individual studies in social and cultural anthropology. Offered both semesters. 1 to 3 units per semester. *Staff*

**334. Topics in Physical Anthropology.** See course description for Anatomy 334. (Also listed as Anatomy 334.) 3 units. *Staff*

**335, 336. Linguistic Theory and Methods.** Basic course for graduate students in the anthropology graduate program. 3 units. *Apte and Casson*

**393. Individual Research in Anthropology.** A course for the student preparing the A.M. thesis or the Ph.D. dissertation. Supervision and guidance of intensive research on a problem approved by the student's departmental advisory committee. 3 units. *Staff*

**402. Interdisciplinary Seminar in the History of the Social Sciences.** A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*



**410. Seminar in the Government, History, and Social Structure of India and Pakistan.** 3 units. *Fox and Staff*

## Art

Professor Markman, *Director of Graduate Studies*; Professors Jenkins, Mueller, and Sunderland; Assistant Professor Lichtenstein

Graduate work in the Department of Art is offered leading to the A.M. degree in art history and is designed to provide basic training in the history of art with specialization in a given field selected by the student after consultation with and approval of the Director of Graduate Studies. Prospective students should present a minimum of 24 semester hours of undergraduate work in the history of art. In special cases a student who does not fulfill this prerequisite may be required to attend prescribed undergraduate courses. A reading knowledge of one foreign language (preferably German) is required; candidates who do not meet this requirement upon admission to the program are expected to do so by the end of their first term in residence.

The program for the A.M. degree in art history consists of 30 units as follows: 12 units in art history; 6 units in an approved minor; 6 units in the major or minor, or other approved subject; and 6 units in thesis. A written thesis is required. The candidate must also pass a written comprehensive examination testing his knowledge of art history and pertinent bibliographical resources.

### For Seniors and Graduates

**233. Early Medieval Architecture.** The development of religious architecture from the time of Constantine to the end of the first Romanesque style in the third quarter of the eleventh century. One course. (3 graduate units.) *Sunderland*

**237. French Renaissance Art.** Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French, or consent of the instructor. One course. (3 graduate units.) *Jenkins*

**244. Neoclassicism.** Origin and evolution of Neoclassicism in the visual arts emphasizing comparison to contemporary stylistic alternatives and international aspects of the style. Prerequisite: Art 66 or consent of instructor. One course. (3 graduate units.) *Connolly*

**247. Problems in the History of Graphic Arts.** Selected topics in the history of prints and drawings. One course. (3 graduate units.) *Mueller*

**249. Problems in Pre-Columbian Art and Archeology.** Architecture, sculpture, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: Art 149, apposite courses in anthropology or Latin American history or consent of instructor. One course. (3 graduate units.) *Markman*

**250. Problems in Latin American Art.** Architecture, painting, sculpture and other arts with emphasis on colonial architecture of Central America. Open to seniors who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. One course. (3 graduate units.) *Markman*

**254. Problems in Modern Architecture.** A particular movement, master or idea studied as a problem in criticism and methodology; influence on design and

building. Prerequisite: Art 61 or consent of instructor. One course. (3 graduate units.) *Brown*

**257, 258. Problems in Modern Art.** Selected topics in nineteenth and twentieth century European art, with emphasis on one or more major movements or masters. Prerequisite: Art 66 or 148 or consent of the instructor. Two courses. (6 graduate units.) *Lichtenstein*

**259. Romanticism.** Emphasis on the French school of painting; sources in English, German, and Spanish art. Prerequisite: knowledge of nineteenth century art and ability to read French; or consent of instructor. One course. (3 graduate units.) *Lichtenstein*

**293, 294. Special Problems in Art History.** Individual study and research. Two courses. (6 graduate units.) *Staff*

## Asian Languages

The course is offered as an enrichment for students interested in the South Asian subcontinent and may be taken as a general elective by advanced undergraduate students. No major work is offered in Hindi-Urdu.

**Hindi-Urdu 200-201. Special Studies in South Asian Languages.** Intensive concentration in advanced Hindi reading and conversation, or specialized graded work in cognate South Asian languages necessary for the advanced student contemplating field work in South Asia. Prerequisite: consent of instructor. 6 units. *Staff*

For courses in Chinese and Japanese, see *Bulletin of Undergraduate Instruction*.

## Biochemistry

Professor Hill, *Chairman* (Medical Sciences Building 1); Professor Gross, *Director of the Genetics Division* (Medical Sciences Building 1); Professor Rajagopalan, *Director of Graduate Studies* (Medical Sciences Building 1); Professors Fridovich, Guild, Handler,\* Harris, Kamin, Kirshner, McCarty, and Tanford; Associate Professors Appel, Greene, Kaufman, Kim, Lynn, Reynolds, Richardson, Sage, Siegel, and Webster. Assistant Professors Bell, Habig, Hall, Holmes, Kredick, Lefkowitz, McKee, Sullivan, and Wheat; Associates Bittikofer, Bonaventura, McCord, Nozaki, and Steinman

Graduate work in the Department of Biochemistry is offered leading to the Ph.D. degree. Preparation for such graduate study may take diverse forms. Undergraduate majors in chemistry, biology, mathematics, or physics are welcome, but adequate preparation in chemistry is essential. Graduate specialization areas include protein structure and function, crystallography of macromolecules, nucleic acid structure and function, lipid biochemistry, membrane structure and function, molecular genetics, enzyme chemistry, and neurochemistry. The Division of Genetics of the department, in cooperation with the University Program in Genetics, offers biochemistry students the opportunity to pursue advanced research and study to fulfill the requirements for the Ph.D. degree.

**204. Introductory Genetics.** An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students, but graduate students may be admitted with the instructor's consent. (Also listed under the

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\*On leave of absence.

University Program in Genetics.) 3 units. *Gross and Others of the University Program in Genetics*

**209-210. Independent Study.** A tutorial designed for students who are interested in either a laboratory or a library project in biochemistry. Units to be determined. *Staff*

**216. Molecular Genetics.** Genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: introductory courses in biochemistry and genetics or consent of instructor. (Also listed under the University Program in Genetics.) 4 units. *Guild and Others of the University Program in Genetics*

**219. Molecular and Cellular Basis of Development.** See course description for Anatomy 219. (Also listed as Anatomy 219, Microbiology, 219, Pathology 219, and Physiology 230.)

**219L.** Optional laboratory offered in conjunction with the lecture. Techniques of organ and cell culture, chromosome morphology, and some electron microscopy as applied to development and differentiation. 2 units. *Bolognesi, Harris, Johnson, Kaufman, and McCarty*

**219S. Seminar.** Optional seminar in conjunction with Biochemistry 219.

**220. Adaptations of Organisms to the Marine Environment.** Basic concepts of biochemistry and variables in the marine environment which evoke adaptive responses. Adaptations at the molecular level are considered, and the general topic of biological fitness. Laboratory experiments utilize basic methods of biochemical analysis. Prerequisites: basic biology and chemistry and consent of instructor. 1 unit. *Bonaventura*

**222. Structure of Biological Macromolecules.** Introduction to the techniques of structure determination by X-ray crystallography and study of some biological macromolecules whose three-dimensional structures have been determined at high resolution. 2 units. *Kim and Richardson*

**224. Biochemistry of Development and Differentiation.** The course represents an extension of topics covered in the first semester course 219. Emphasis will be on the control of transcription and translation of mRNA in mammalian cells. These studies include gene amplification, postsynthetic modifications of chromosomal proteins, as a result of hormone induction. Specific systems will include the development of the mammary gland, the pancreas, and the chick oviduct. 1 unit. *McCarty*

**241. General Biochemistry.** An introductory survey of fundamental aspects of biochemistry with emphasis on the structure of macromolecules, mechanism of enzyme action, metabolic pathways, biochemical genetics, and the structure and functions of special tissues. Designed for medical students; graduate students only with consent of instructor. 4 units. *Hill and Staff*

**248. Introductory Biochemistry.** The chemistry of proteins, lipids, carbohydrates, and nucleic acids and the metabolic interrelationships of these compounds. Prerequisite: organic chemistry. (Also listed as Botany 248 and Zoology 248.) 3 units. *Kim and Staff*

**276. Comparative and Evolutionary Biochemistry.** Lectures and discussion of the origin of life, evolution of genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques include salt fractionation, electrophoresis, ion-exchange and molecular

exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of instructor. Given at Beaufort. 6 units. *Sullivan*

**282. Experimental Genetics.** Laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. Prerequisite: consent of instructor. (Also listed under the University Program in Genetics.) 2 units. *Hall and Others in the University Program in Genetics*

**284. Current Topics in Genetic Mechanisms.** A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed under the University Program in Genetics.) 1 unit. *Hall and Others of the University Program in Genetics*

**286. Current Topics in Immunochemistry.** The structure, function, and specificity of antibodies. Immunogenicity and tolerance with special emphasis on current theories of the diversity and synthesis of antibody molecules. 2 units. *Sage*

**288. The Carbohydrates and Lipids of Biological Systems.** The subjects will be considered in the following two general categories: (a) the relationship between chemical structure and biological function, and (b) biosynthesis and catabolism. 2 units. *Kaufman*

**290. Bioenergetics.** Biological mechanisms of transduction of energy (covalent, ionic, photonic, and electric) will be considered, using photosynthetic, oxidative, phosphorylative, and glycolytic systems as examples. Since many of the above processes occur in membranous systems, the role and function of membranes in these processes will also be considered. 2 units. *Lynn*

**293. Macromolecules.** The structure of biological macromolecules and their relations to biological functions. Prerequisites: physical chemistry equivalent to Chemistry 161-162. 4 units. *Hill, Kim, Richardson, and Tanford*

**295. Enzyme Mechanisms.** A study of current views of the modes of action of enzymes and of the techniques which are found most useful in elucidating these matters. Theory and practice will be given equal emphasis. 3 units. *Fridovich and Rajagopalan*

**296. Biological Oxidations.** A lecture, conference, and seminar course on the mechanism of electron transport and energy conservation in purified enzymes and in organized systems such as the mitochondrion, the endoplasmic reticulum, and the chloroplast. 2 units. *Fridovich, Kamin, Rajagopalan, and Siegel*

**297. Intermediary Metabolism.** The synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids will be discussed in detail with emphasis on energy transformation and metabolic interrelationships. 3 units. *Bell, Greene, Kirshner, and Siegel*

**299. Nutrition.** This course examines the experimental basis for the identification and quantification of requirements for calories, macronutrients, and micronutrients—vitamins and minerals; the biochemistry of nutrition with the assessment of nutriture; and the biological effects of deficiency or excess of nutrients. The course seeks to define optimal nutriture and will search for factual bases for common beliefs on nutrition. Informal lectures and, if possible, student seminars. Prerequisite: a basic biochemistry course, the equivalent, or consent of instructor. 2 units. *Kamin*



**302. Neurochemistry.** Aspects of structure, function, and metabolism unique to the nervous system. Properties and interactions of neuroreceptors and nerve-muscle relationships. 3 units. *Appel, Bell, Kaufman, Kirshner, and Vanaman*

**345, 346. Biochemistry Seminar.** Required of all biochemistry students. 1 unit per semester. *Bell*

**351, 352. Genetics Seminar.** Required of all students specializing in genetics. (Also listed under the University Program in Genetics.) 1 unit per semester. *Hall and Others of the University Program in Genetics*

**390. Biochemistry of Membranes.** Physical and chemical properties of biological membranes. Properties of constituent lipids and proteins in relation to membrane function. Prerequisite: Biochemistry 293 or its equivalent. 2 units. *Bell, Reynolds, and Tanford*

## Botany

Professor Wilbur, *Chairman* (149 Biological Sciences Building); Associate Professor Searles, *Director of Graduate Studies* (257 Biological Sciences); Professors Anderson, Billings, W. Culberson, Hellmers, Johnson, Naylor, Philpott, Stone, and White; Associate Professors Antonovics, Barber, Boynton, Knoerr, and Strain; Assistant Professors Blankley and Christensen; Lecturer C. Culberson

Graduate work in the Department of Botany is offered leading to the A.M. (nonthesis), M.S. (thesis), and Ph.D. degrees. Before undertaking graduate study in botany a student should have had in his undergraduate program at least 12 semester hours of botany beyond an elementary course, and related work in biological sciences. Some work in chemistry and physics will be desirable and, for some phases of botanical study, a necessity. Graduate Record Examination scores are required of all applicants. The student's graduate program is planned to provide a broad basic training in the various fields of botany, plus intensive specialization in the field of the research problem.

**202L. Phytoplankton Systematics.** Taxonomy and classification of marine phytoplankton; general characteristics, phytogeography, life histories, and study techniques. Individual projects. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Blankley*

**203. Cytogenetics.** Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variation, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. One course. (3 graduate units.) *Anderson*

**203L. Cytogenetics.** See Botany 203. Lectures and laboratories. One course. (4 graduate units.) *Anderson*

**204L. Marine Microbiology.** The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Blankley*

**206L. Anatomy of Woody Plants.** Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations, and for study of micro and ultrastructures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. (Also listed as Forestry 206.) Prerequisite: college botany or biology. One course. (4 graduate units.) *Philpott*

**207L. Microclimatology.** (Also listed as Forestry 207.) One course. (3 graduate units.) *Knoerr*

**209L. Lichenology.** Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. One course. (3 graduate units.) *W. Culberson or C. Culberson*

**210L. Bryology.** Morphological, systematic, and ecological characteristics of mosses and liverworts. One course. (3 graduate units.) *Anderson*

**211L. Marine Phycology.** An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. Given at Beaufort. One and one half courses. (6 graduate units.) *Searles*

**212L. Phycology.** Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. One course. (4 graduate units.) *Searles*

**214L. Biological Oceanography.** See Zoology 214. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barber*

**217L. Environmental Instrumentation.** (Also listed as Forestry 217.) Prerequisite: consent of instructor. One course. (3 graduate units.) *Knoerr*

**221L. Mycology.** Field and laboratory study of vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in local flora. Prerequisite: one year of biological science. One course. (4 graduate units.) *Johnson*

**225T, 226T. Special Problems.** Students with adequate training may do special work in the following fields. Credit to be arranged. (1-4 graduate units.)

1. Cytology: Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Ecology. *Christensen*
7. Lichenology. *Culberson*
8. Physiology. *Hellmers*
9. Bacteriology; Mycology. *Johnson*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics of Flowering Plants. *Stone*
14. Ecology. *Strain*
15. Anatomy and Morphology of Vascular Plants. *White*
16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

**233L. Microbiology.** Introduction to bacteriology, virology, cell biology, and immunology. Structure, metabolism, and growth of bacteria; the properties of bacterial and animal viruses; and basic immunology. (Also listed as Microbiology 233.) One course. (3 graduate units.) *Amos (Microbiology), Burns (Microbiology), Joklik (Microbiology), or Willett (Microbiology)*

**235. Evolutionary Systematics.** See Zoology 235. 3 units. *Bailey (Zoology), Lundberg (Zoology), and Stone*

**235L. Evolutionary Systematics.** Same course as 235 with laboratory included. 4 units. *Bailey (Zoology), Lundberg (Zoology), and Stone*

**236S. Major Global Ecosystems.** Study of a single global ecosystem such as arctic-alpine, desert, tropical rainforest, grassland, or coniferous forest, including the place and effects of both primitive and modern man. One course. (3 graduate units.) *Billings*

**242L. Systematics.** Principles of vascular plant taxonomy, with practice in collection and identification of local flora. Lectures, laboratories, and field trips. Prerequisite: one year of biology. 4 units. *Wilbur*

**245L. Plant Diversity.** Major groups of the living plants, their evolutionary origins and phylogenetic relationships. Prerequisite: introductory biology. 4 units. *Culberson and White*

**246L. Ecology of Plants.** Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisites: introductory biology and one other course in biology. 4 units. *Billings, Christensen, or Strain*

**248. Introductory Biochemistry.** The chemistry of proteins, lipids, carbohydrates, and nucleic acids; metabolic interrelationships of these compounds. Prerequisite: Chemistry 151, one year of college physics (second semester may be concurrent), and Mathematics 32. (Also listed as Biochemistry 248). One course. (3 graduate units.) *Staff*

**250L,S. Plant Biosystematics.** Descriptive and experimental procedures used to assess systematic implications of vascular plant evolution. Laboratory, discussion, and field oriented problems. Prerequisites: basic courses in systematics and genetics. One course. (4 graduate units.) *Stone*

**251L. Plant Physiology.** The principal physiological processes of plants, including water relations, mineral nutrition, synthesis and use of foods, and growth phenomena. Prerequisites: introductory college biology and one year of chemistry; organic chemistry is desirable. 4 units. *Naylor*

**252L. Plant Metabolism.** The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151L or equivalent; organic chemistry is recommended. One course. (4 graduate units.) *Naylor*

**256. Physiological Role of Minerals and Water.** Availability, uptake, transport, and function of minerals and water in plant growth. Prerequisite: Botany 151L or equivalent. One course. (3 graduate units.) *Hellmers*

**257S. Principles of Plant Distribution.** Interpretation of floristic and ecological plant geography. Prerequisite: Botany 146L or equivalent. One course. (3 graduate units.) *Billings*

**258. Physiology of Growth and Development.** Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Lectures. Prerequisite: Botany 151L or equivalent; organic chemistry is recommended. One course. (3 graduate units.) *Naylor*

**258L. Physiology of Growth and Development.** See Botany 258. Lectures and laboratories. Half course. (2 graduate units.) *Naylor*

**259. The Environment.** Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 146L or equivalent. One course. (3 graduate units.) *Billings*

**260L. Plant Anatomy.** A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or consent of instructor. 4 units. *White*

**265L. Physiological Plant Ecology.** The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 146L and 151L or equivalent. One course. (3 graduate units.) *Strain*

**267L. Plant Community Ecology.** Concepts and methods of plant synecology. Introduction to the plant communities of North Carolina. Prerequisites: Botany 142L and 146L or equivalent, and consent of instructor. One course. (3 graduate units.) *Christensen*

**268L,S. Quantitative Plant Ecology.** Experimental design, statistics, and analysis of pattern, population growth, diversity, community composition, and ecosystem dynamics. Prerequisites: statistics and Botany 146L or Botany 246L or equivalent and consent of instructor. One course. (3 graduate units.) *Christensen*

**280. Principles of Genetics.** Structure and properties of genes and chromosomes, and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Botany 180, Zoology 180, and Zoology 280.) One course. (3 graduate units.) *Antonovics, Boynton, and Gillham (Zoology)*

**280L. Principles of Genetics.** Same course as 280 with laboratory included. One course (3 graduate units.) *Antonovics, Boynton, and Gillham (Zoology)*

**285S. Population Genetics.** A seminar and lecture course devoted to the analysis of the current literature in population genetics. Prerequisites: genetics or Botany 280 or equivalent and consent of instructor. (Also listed as Genetics 285.) One course. (3 graduate units.) *Antonovics*

**286. Evolutionary Mechanisms.** See course description for Zoology 286. (Also listed as Zoology 286 and under the University Program in Genetics). One course. (3 graduate units.) *Antonovics and H. Wilbur (Zoology)*

**287S. Quantitative Genetics.** Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental, and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 180 or Botany 280 or equivalent and consent of instructor. One course. (3 graduate units.) *Antonovics*

**295S, 296S. Seminar.** Credit to be arranged. *Staff*

**300. Tropical Biology: An Ecological Approach.** Highly intensive, field-oriented course conducted in Costa Rica under auspices of Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this *Bulletin*. 6-8 units. *Staff*

**305. Tropical Studies.** Highly intensive, field-oriented courses conducted in Latin America under auspices of Organization for Tropical Studies. For additional information refer to Special and Cooperative Programs in this *Bulletin*. 4-8 units. *Staff*

**344S. Advanced Topics in Micrometeorology and Biometeorology.** See course description for Forestry 344. (Also listed as Forestry 344.) 2 units. *Knoerr*

**359-360. Research in Botany.** Individual investigation in the various fields of botany. Credits to be arranged. *All Members of the Graduate Staff*



**The University Program in Genetics.** Genetics courses offered by the Botany Department are an integral part of this interdepartmental program. Refer to the announcement in this *Bulletin* under the University Program in Genetics for description of the offerings.

204, Introductory Genetics; 215, Bacteriophage: Structure and Function; 216, Molecular Genetics; 236, Human Genetics; 280, Principles of Genetics; 282, Experimental Genetics; 284, Current Topics in Genetic Mechanisms; 285, Population Genetics; 287S, Quantitative Genetics; 336, Immunogenetics; 351-352, Genetics Seminar.

**Program in Tropical Biology.** Fellowships are available for travel and subsistence in field-oriented programs in Central America. Refer to the section Organization for Tropical Studies in the *Bulletin* in the chapter Special and Cooperative Programs.

**The University Program in Marine Sciences.** Interdisciplinary programs emphasizing marine botany are available. Refer to the section in this *Bulletin* entitled Marine Sciences—The University Program.

## Business Administration

Thomas F. Keller, Ph.D., *Dean* (115 Social Science)

Professors Baligh, Cohen, Lewin, Peterson, Associate Professors Abdel-Khalik, Baker, Battle, Burton, Dellinger, and Morse; Assistant Professors Aldrich, Damon, Espejo, Kuhn, Magat, Maier, Scheiner, Taylor, Vander Weide, Westbrook and Zalkind

The Graduate School of Business Administration offers work leading to the M.B.A., M.S., and the Ph.D. in Management. The program of study leading to the first two degrees are described in the *Bulletin of the Graduate School of Business Administration*. The Ph.D. program is designed for students who desire to enter either the academic profession or advanced and specialized administrative research positions. The program accepts students with bachelor's degree preparation and normally requires three to four years.

One year of study (30 units) beyond completion of the Duke M.B.A. degree or its equivalent is planned for each doctoral candidate. The year of study should include two courses in advanced economic theory, two courses in mathematics or statistics, and three courses in an elected field of administration. The latter are individually designed and are offered on a tutorial basis to provide extensive reading in the historical and current literature, and a demanding research program.

The requirements of the Graduate School are applicable to students in the Ph.D. program in business administration.

All 200-level courses in the Department of Management Sciences are open to graduate students from other departments. They are listed in the *Bulletin of Undergraduate Instruction*.

**300. Managerial Economics I.** Fundamental theory of the firm on which analysis and planning of operations for an economic enterprise are based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, alternative market forms, the rationale for and form of government regulation, and production and investments examined through the use of economic theory. Emphasis on planning problems of the firm in alternative market settings and development of students' abilities to employ economic reasoning in decision-making. 5 units.

**301. Managerial Economics II.** Focuses on developing an understanding of

the economic environment of the organization with emphasis on the determination of price level, rate of growth, interest rates, and the level of aggregate income, employment, and output in the economy. Examination of such current economic issues as inflation, international economic relations, and unemployment. 3 units.

**309.1-9. Research in Managerial Economics.** 1 to 6 units.

**310. Mathematics for Management.** Basic mathematical structures and techniques for analyzing decision problems of an enterprise. Topics include sets, relations, functions of several variables, classical optimization techniques, linear algebra, linear programming, and probability theory. Applications, cases, and problems are used to illustrate the relevance of quantitative analysis in a decision context. Conducted in parallel with the foregoing is a sub-course on computer systems. Topics include computer technology, hardware, software, use of computer systems, and the PL/I computer language. Problems from other courses in the first semester are solved using the computer. 5 units.

**311. Statistical Analysis for Management Decisions.** Builds upon Business Administration 310 and extends to an examination of classical and Bayesian statistics as a framework and methodology for decision-making. Included are topics such as sampling theory, estimation, hypothesis-testing, regression and correlation analysis, utility theory, and statistical decision theory. 4 units.

**312. Operations Research.** The development and study of quantitative models useful for structuring and solving strategy problems of the firm, and used in the third and fourth semester strategy courses. Emphasis on structuring problems in terms of quantitative models, generating solutions using both analytical and simulation approaches with and without computers, performing sensitivity analysis, implementing solutions, and developing a perspective about the role of quantitative models in management decision processes. 3 units.

**313. Advanced Operations Research.** Problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or the development of new ones. 3 units.

**319.1-9. Research in Quantitative Methods.** 1 to 6 units.

**320-321. Organization Theory and Management I, II.** Provides the first year M.B.A. degree student with an understanding of macroscopic (corporate level) and microscopic (small-group and individual level) organizational phenomena. At the macroscopic level, these courses are concerned with the study of organizations as socioeconomic-political systems for collective action embedded in an uncontrollable environment. At the microscopic level, these courses examine the social and psychological foundations necessary to understand the behavior and dynamics of individuals and small groups within organized settings as well as the administrative strategies available to the firm for influencing and modifying such behavior. 3 units each semester.

**329.1-9. Research in Organization Theory and Management.** 1 to 6 units.

**330. Accounting Systems I.** Introduction to the types of information requirements imposed on the firm by agencies in its environment and development an understanding of the activities of the firm within the framework of a

financial accounting system designed to satisfy these information requirements. Emphasis on the study of financial accounting, reporting, and measurement problems from a theoretical and an applied basis, using cases and topical problems in financial accounting as a foundation. 3 units.

**331. Accounting Systems II.** The relationships between the strategies of the firm as reflected in its planning activities and the impact of those plans on the data gathering, reporting activities, and operations inside the firm. The concept of the master budget establishes a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system to serve as a mechanism for internal management and control. Specific topics including budgeting, standard costing, control in a programmed environment, capital budgeting, and funds analysis. 3 units.

**333. Controllership.** Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 3 units.

**334. External Reporting and Auditing.** Builds on the information systems sequence of the first year and the public policy course, in terms of developing requirements of the system for reporting to parties external to the firm who have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 3 units.

**335. Management Information and Control Systems.** Problems associated with the design and operation of the information systems necessary to support strategic planning of an organization and to support the organization's control system. The role of information in planning and control, the economics of information, the dynamics of information flows, technologies of information systems, information system design, data base construction and maintenance, and reporting systems. 3 units.

**339.1-.9. Research in Information and Accounting Systems.** 1 to 6 units.

**345. Legal Environment of the Firm.** Emphasis on the legal system, the process by which laws are formulated and changed, and the type and forms of legal constraints imposed on firms. Also examined are major legislation, court cases, and regulation by federal agencies which affect the firm's decisions. 2 units.

**346. Public Policy of the Firm.** Builds on the theory of market failure to describe the rationale for societal intervention in business activities and reasonable firm responses. Topics include environmental action, monopoly relations, discrimination, poverty, consumer issues, and problems arising from shifts in demand and supply. 3 units.

**349.1-.9. Research in Public Policy and Social Responsibility.** 1 to 6 units.

**355. Financial Strategy.** Strategic problems associated with the acquisition of financial resources from the external market and their effective utilization and control within the organization. Capital markets, evaluation of the firm, short-run resource planning (cash, inventory, receivables, and short and intermediate-term financing), and long-run resource planning (investment in long-lived assets, leasing, debt and equity financing, dividend policy, and the cost of capital). Institutional aspects of financial markets are emphasized to provide necessary insights into the problems of planning financial strategy. 3 units.



**356. Finance.** Management of the financial affairs of the firm in its attempt to develop an optimal capital structure: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 3 units.

**359.1-.9. Research in Finance.** 1 to 6 units.

**365. Market Strategy.** Strategic problems associated with providing a set of products or services to consumers; and with procuring resources and services from suppliers that contribute to objectives of the organization. The analysis of market opportunities, product mix strategy, market segmentation, design of distribution and procurement channels, price and promotion strategy, and sales force decisions. 3 units.

**366. Marketing.** Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involve a more detailed discussion of the existing market environment of the firm. Problems studied are consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 3 units.

**369.1-.9. Research in Marketing.** 1 to 6 units.

**375. Operations Strategy.** Strategic problems associated with the design, operation, and control of the transformation processes utilized by an organization in producing goods and services for its external markets. Specific attention is given to systems design (product design, process design, capacity planning), system operation (production planning, scheduling) and system control (inventory control, quality control). 3 units.

**376. Production.** Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered—first, the design (or planning) of manufacturing systems and second, their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods and processes, facilities planning. Sub-topics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 3 units.

**379.1-.9. Research in Production.** 1 to 6 units.

**381. Management of Financial Institutions.** Explores various ways in which management science techniques can be applied to the management problems of financial institutions, especially commercial banks. The course will examine several types of financial institutions, consider the role that they play in the American economy, and focus on the use of management science techniques for helping executives cope with planning, decision-making, and control problems. 3 units.

**382. Multinational Enterprise.** Focuses on the nature and consequences of multinational corporations. Studies the international economic environment in which multinational corporations operate, the problems of managing a multinational corporation, and the public policy toward multinational corporations. 3 units.

**385. Strategy of the Organization I.** The problems of formulating strategy for the organization, of decomposing aggregate strategy problems into manage-



able sub-problems, and of integrating and coordinating strategies designed for sub-problems into a consistent and implementable strategy for the organization as a whole. Specific attention is given to objectives of the organization in a complex environment, the objective setting process, short- and long-run strategy planning, methods for decomposing strategy planning, mechanisms for achieving integration and coordination of strategy, and the role of management information systems in strategy planning. 2 units.

**386. Strategy of the Organization II.** Integrates the strategy planning and control process, organization design, and management information systems in order to achieve the objectives of the organization. Strategy formulation, implementation, and control from the viewpoint of the organization as a whole and to the design of structures for the coordination and control of the organization. The cooperation and competitive relations of the firm with its environment are also investigated. 4 units.

**390. The Practicum.** A significant experience in applying the concepts, theories, and methods of analysis learned in the program to a real, complex problem of an economic enterprise. It should include the analysis of a situation and the explicit formulation of a problem. The important task of identifying and specifying the problem is an integral part of the practicum.

The practicum report should propose a solution to the problem and should contain the supporting explanation and logic. The solution should be one that can be implemented, not requiring unavailable resources. 3 units.

**391.1-.9. Special Topics in Management.** Elective courses may be offered as special topics in management on an occasional basis depending on the availability and interests of students and faculty. Such courses might pertain to management of the nonprofit enterprise, advanced organization theory, marketing research, or manpower planning. 1 to 5 units.

**392-393. Tutorial in Interdisciplinary Areas.** 1 to 6 units.

**397. Dissertation Research.** 1 to 6 units.

## Chemistry

Professor Quin, *Chairman* (101 Gross Chemical Laboratory); Professor Chesnut, *Director of Graduate Studies* (329 Gross Chemical Laboratory); Professors Bradsher, Hobbs, Jeffs, Krigbaum, McPhail, Parham, Poirier, Smith, Strobel, Wells, and Wilder; Associate Professors Henkens, Lochmüller, Palmer, and Porter; Assistant Professors Baier, Baldwin, Crumbliss, Gutknecht, Neilson, Sarneski, and Shaw; Adjunct Associate Professors Ghiradelli, Pitt, Rosenthal, and Spielvogel

In the Department of Chemistry graduate work is offered leading to the A.M. and Ph.D. degrees. Before undertaking a graduate program in chemistry, a student should have taken an undergraduate major in chemistry, along with related work in mathematics and physics.

Graduate courses in the department are offered in the fields of analytical, inorganic, organic, and physical chemistry. Research programs are active in all these fields.

A booklet providing detailed information on the department is available from the Director of Graduate Studies.

### For Seniors and Graduates

**201. Molecular Spectroscopy.** Selected spectroscopic methods in the study of

molecular structure. Symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra; examples from both inorganic and organic chemistry. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**203. Quantum Chemistry.** Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundation of quantum theory. Emphasis on the application of molecular orbital theory to organic and inorganic systems. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**205. Structure and Reaction Dynamics.** Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Emphasis on the use of kinetic techniques to solve problems in reaction mechanisms. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**207. Principles of Thermodynamics, Diffraction, and Kinetics.** Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**230. Environmental Oceanography.** Chemical, biological and geological aspects of pollution in the marine environment. The interaction of man with natural marine processes on shore lines and shelves. Application of marine science to compatible utilization of marine resources. Prerequisite: consent of instructor. Physical chemistry is recommended. (Also listed as Marine Sciences 230.) Given at Beaufort. One and one half courses. (6 graduate units.) *Baier and Staff*

**240. Chemical Oceanography.** Distribution, alteration, and transport of chemical species in the marine environment. *R/V Eastward* cruise to gather samples for evaluating chemical processes in the ocean. Prerequisite: consent of instructor. Physical chemistry is recommended. Includes lectures, laboratory work, and field trips. (Also listed as Marine Sciences 240.) Given at Beaufort. One and one half courses. (6 graduate units.) *Baier and Staff*

**275, 276. Advanced Studies.** (1) Analytical chemistry; (2) inorganic chemistry; (3) organic chemistry; and (4) physical chemistry. Open to especially well prepared undergraduates by consent of department. Two courses. (6 graduate units.) *Staff*

## For Graduates

**300. Basic Statistical Mechanics.** Fundamentals of quantum and classical statistical mechanics using the ensemble approach. Emphasis on systems of weakly interacting particles with internal degrees of freedom. 3 units. *Staff*

**302. Basic Quantum Mechanics.** The fundamentals of quantum mechanics with special emphasis on chemical applications. Topics included are: linear algebra, the uncertainty relations, angular momentum, perturbation theory and time dependent phenomena, molecules in electromagnetic fields, group methods, and electron correlation. 3 units. *Staff*

**303, 304. Special Topics in Physical Chemistry.** Presentation of one or more topics of staff interest such as advanced methods in crystallography, light scattering and small angle X-ray diffraction, application of ESR spectroscopy to chemical problems, electronic spectroscopy of proteins, group theory, intermolecular forces, liquid crystals, methods of determining the rates of elementary steps in reaction kinetics, physical chemistry of aerosols, physical-chemical methods of polymer characterization, structure and bonding in metallo-

enzymes, statistical mechanics of fluids, topics in structural chemistry, and triplet excitons. 1 to 3 units per semester. *Staff*

**310. Theoretical and Structural Inorganic Chemistry.** An advanced study of theoretical concepts and structural determination techniques as applied to inorganic systems. Areas included are crystal field and ligand field theories, magnetic susceptibility, and electronic, infrared, and Raman spectroscopy. 3 units. *Crumbliss or Palmer*

**312. Inorganic Reactions and Mechanisms.** Chemistry of main group and transition elements. Emphasis on current developments in synthetic and mechanistic studies of inorganic, organometallic, and organometalloid compounds. 3 units. *Crumbliss or Wells*

**313, 314. Special Topics in Inorganic Chemistry.** Lectures, oral reports, and discussions on advanced topics and recent advances in the field of inorganic chemistry. Examples of topics which may be discussed are bioinorganic chemistry, fluxional molecules, homogeneous catalysis, synthesis and properties of selected groups of compounds, and new physical methods. 1 to 3 units per semester. *Staff*

**320. Synthetic Organic Chemistry.** A study of the scope and limitations of the more important types of reactions in synthetic organic chemistry. Some discussion of the rapidly developing use of transition metals, complex hydrides, and photochemistry will be included. 3 units. *Baldwin, Bradsher, or Parham*

**322. Organic Reactive Intermediates.** A discussion of reactive intermediates in organic chemistry. Topics will include carbanions, carbenes, carbonium ions, free radicals, photochemical excited states, and other reactive species. 3 units. *Porter or Wilder*

**323, 324. Special Topics in Organic Chemistry.** Advanced topics and recent developments in the field of organic chemistry. Each year heterocyclic chemistry or the chemistry of natural products will be among the topics presented. Lectures, and written and oral reports. 1 to 3 units per semester. *Staff*

**330. Chemical Separation Methods and Kinetics in Analytical Chemistry.** The principles of rate processes and diffusion; plate-theory, adsorption and chemical selectivity. Thermodynamics of processes leading to differential migration in chromatography. Kinetic methods of analysis with emphasis on the quantitative determination of concentration in biological and non-biological systems. 3 units. *Staff*

**331, 332. Special Topics in Analytical Chemistry.** An advanced treatment of important areas in modern analysis. Possible topics include: electrochemistry, small computer applications, magnetic resonance, and problem-solving approaches. 1 to 3 units per semester. *Staff*

**334. Chemical Instrumentation and Applied Spectroscopy.** Principles of instrumental design. Topics covered include input transducers, dispersive devices, servo systems, operational amplifiers, and digital logic. An introduction to advanced topics in analytical spectroscopy. Fourier transform methods in infrared and n.m.r. spectroscopy, X-ray fluorescence, applications of lasers to high-speed measurements, and fast-scan spectrophotometry. 3 units. *Staff*

**373, 374. Seminar.** Required of all graduate students in chemistry. One hour a week discussion. 1 unit per semester. *All Members of the Graduate Staff*

**375, 376. Research.** The aim of this course is to give instruction in methods used in the investigation of original problems. Individual work and conferences. 1 to 6 units. *All Members of the Graduate Staff*

**377. Research Orientation Seminar.** A survey of departmental research. Required of all entering graduate students in chemistry. Prerequisite: consent of the Director of Graduate Studies. 1 unit. *All Members of the Graduate Staff*

## Classical Studies

Professor Oates, *Chairman* (135 Carr); Professor Newton, *Director of Graduate Studies* (326 Carr); Professors Richardson and Willis; Associate Professor Stanley; Assistant Professors Burian and Rigsby; Visiting Lecturer Levy

The Department of Classical Studies offers two programs leading to the Ph.D. degree, one with emphasis on literature and philology, the other with emphasis on ancient history and archeology. For regular admission to the program in literature and philology, a student must offer three years of college study above the elementary level in one of the classical languages and two college years in the other. Students wishing to enter the program in ancient history and archeology will be required on entrance to demonstrate satisfactory competence in both Greek and Latin for reading in the primary sources; failure to demonstrate such competence will require modification of the student's program to repair the deficiency.

The department's special requirements in addition to the general requirements of the University for the Ph.D. degree set forth in the section on Program Information of this *Bulletin* are presented in a sheet that may be obtained from the Director of Graduate Studies. They include special requirements in seminars, course work, and the preliminary examination for the Ph.D. degree.

A reading knowledge of German and French is required of all candidates for the Ph.D. degree. The candidate should meet one of the language requirements by the end of his first term in residence and the other by the end of his third term.

### GREEK

#### For Seniors and Graduates

**200. Graduate Reading.** Open to qualified undergraduates by consent of the instructor. One course. (3 graduate units.) *Staff*

**203. Homer.** The *Iliad* and *Odyssey*; the problems of language and structure in the epic; present state of Homeric scholarship. One course. (3 graduate units.) *Levy or Stanley*

**205. Greek Lyric Poets.** Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. One course. (3 graduate units.) *Burian*

**206. Aeschylus.** The *Oresteia*, with study of the form of *Agamemnon* and its place in the design of the trilogy. One course. (3 graduate units.) *Willis*

**208. Sophocles.** The Theban plays; the structure and style of Sophoclean tragedy. One course. (3 graduate units.) *Stanley*

**209. Euripides.** Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. One course. (3 graduate units.) *Stanley*

**210. Aristophanes.** Origin and development of Greek comedy; representative plays of Aristophanes. One course. (3 graduate units.) *Burian*

**221. Early Greek Prose.** Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. One course. (3 graduate units.) *Willis*



**222. Thucydides.** The *History*; Thucydides' historical method and style. One course. (3 graduate units.) *Willis*

**223. Greek Orators I.** Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. One course. (3 graduate units.) *Staff*

**224. Greek Orators II.** Aeschines' *Against Ctesiphon* and Demosthenes' *On the Crown* in the light of fourth century political history and rhetorical development. One course. (3 graduate units.) *Willis*

**225. Plato.** Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. One course. (3 graduate units.) *Stanley*

**231. Hellenistic Poetry.** The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. One course. (3 graduate units.) *Stanley*

**241. Advanced Prose Composition.** Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. Half course. (1 graduate unit.) *Willis*

### For Graduates

(At least two of these are offered each year.)

**301. Greek Seminar I.** 3 units.

**302. Greek Seminar II.** 3 units.

**303. Greek Seminar III.** 3 units.

**304. Greek Seminar IV.** 3 units.

**305. Greek Seminar V.** 3 units. *Stanley*

**306. Greek Seminar VI.** 3 units. *Oates*

**311. Proseminar in Papyrology.** 3 units. *Willis*

**313. Proseminar in Greek Epigraphy.** 3 units. *Rigsby*

**321. Seminar in Literary Papyri.** 3 units. *Willis*

**323. Seminar in Documentary Papyri.** 3 units. *Oates*

**399. Directed Reading and Research.** Variable credit. *Stanley*

### LATIN

#### For Seniors and Graduates

**200. Graduate Reading.** Open to qualified undergraduates by consent of the instructor. One course. (3 graduate units.) *Newton or Stanley*

**201. The Verse Treatise.** The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura*, Vergil's *Georgics*, and Ovid's *Ars Amatoria*; attention to Cicero's *Aratea*, the *Astronomica* of Manilius, Horace's *Ars Poetica*, and Ovid's *Fasti*. One course. (3 graduate units.) *Newton or Richardson*

**202. Roman Satire.** A survey of the genre with concentration on Horace, Juvenal, and Persius. One course. (3 graduate units.) *Richardson*

**203. Epic: Vergil.** The *Aeneid*. One course. (3 graduate units.) *Newton*

**204. Epic: Lucan and Statius.** The development of the Roman epic in the Silver Age. One course. (3 graduate units.) *Richardson*

**207. The Prose Epistle.** The letter as a vehicle of communication and as a literary form. One course. (3 graduate units.) *Richardson*

**208. The Epistle in Verse.** The letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. One course. (3 graduate units.) *Staff*

**209. Fragments of Early Latin.** The remains of Latin poetry of the third and second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. One course. (3 graduate units.) *Stanley*

**210. Lyric and Occasional Poetry.** Shorter verse forms: epigram, pastoral, song, and panegyric. One course. (3 graduate units.) *Staff*

**211. Roman Oratory I.** The literary history and criticism of Roman oratory. One course. (3 graduate units.) *Richardson*

**212. Roman Oratory II.** A continuation of Latin 211. One course. (3 graduate units.) *Staff*

**221. Medieval Latin I.** Latin literature of late antiquity, from Prudentius to the Carolingian Revival. One course. (3 graduate units.) *Newton*

**222. Medieval Latin II.** Literature in Latin from Charlemagne to the Renaissance. One course. (3 graduate units.) *Newton*

**225. Latin Paleography.** Latin book hands from the Roman Empire to the Italian Renaissance. One course. (3 graduate units.) *Newton*

**241. Advanced Latin Composition.** Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. Half course. (1 graduate unit.) *Richardson*

**250. Teaching Latin.** Objectives, methods, and problems; the study of textbooks, programs, and related materials. One course. (3 graduate units.) *Staff*

## For Graduates

(At least two of these are offered each year.)

**301. Latin Seminar I.** 3 units.

**302. Latin Seminar II.** 3 units.

**303. Latin Seminar III.** 3 units.

**304. Latin Seminar IV.** 3 units.

**305. Latin Seminar V.** 3 units. *Richardson*

**306. Latin Seminar VI.** 3 units. *Newton*

**312. Proseminar in Latin Palaeography.** 3 units. *Newton*

**314. Proseminar in Latin Epigraphy.** 3 units.

**315. Proseminar in Roman Law.** 3 units.

**399. Directed Reading and Research.** Variable credit. *Newton*

## CLASSICAL STUDIES

### For Graduates

**301. Introduction to Classical Philology.** Introduction to the bibliography and principal disciplines of the field. 3 units. *Willis and Graduate Staff*

**351. The Teaching of Classics.** The student is introduced to the problems involved in teaching the classics. Regular classrooms observation and some teaching experience. No credit. *Staff*

## CLASSICAL STUDIES (ANCIENT HISTORY)

**253. Greece to the Orientalizing Period.** One course. (3 graduate units.) *Rigsby*

**254. The Age of the Tyrants and the Persian Wars.** One course. (3 graduate units.) *Oates*

**255. The Age of Pericles.** One course. (3 graduate units.) *Oates*

**256. The Fourth Century through Alexander.** One course. (3 graduate units.) *Oates*

**257. Social and Cultural History of the Hellenistic World from Alexander to Augustus.** One course. (3 graduate units.) *Rigsby*

**258. Social and Cultural History of the Graeco-Roman World.** One course. (3 graduate units.)

**260. The History of Rome to 146 B.C.** One course. (3 graduate units.) *Staff*

**261. The Roman Revolution, 146-30 B.C.** One course. (3 graduate units.) *Oates*

**262. Rome under the Julio-Claudians.** One course. (3 graduate units.) *Raschke*

**263. From the Flavian Dynasty to the Severan.** One course. (3 graduate units.) *Raschke*

**264. From Septimius Severus to Constantine.** One course. (3 graduate units.) *Staff*

**270. The Rise of the Hellenistic Kingdoms.** One course. (3 graduate units.) *Oates*

**271. The Hellenistic World, 250-31 B.C.** One course. (3 graduate units.) *Oates*

### For Graduates

(At least two of these are offered each year.)

**321. Seminar in Ancient History I.** 3 units.

**322. Seminar in Ancient History II.** 3 units.

**323. Seminar in Ancient History III.** 3 units.

**324. Seminar in Ancient History IV.** 3 units.

**325. Seminar in Ancient History V.** 3 units. *Oates*

**326. Seminar in Ancient History VI.** 3 units. *Oates*

**327. Seminar in Byzantine History.** 3 units. *Rigsby*

**399. Directed Reading and Research.** Variable credit.

## CLASSICAL STUDIES (ARCHEOLOGY)

### For Seniors and Graduates

**231. Greek Sculpture.** Techniques and styles of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural

sculpture. One course. (3 graduate units.) *Younger*

**232. Greek Painting.** Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. One course. (3 graduate units.) *Younger*

**235. Roman Architecture.** Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early Empire. One course. (3 graduate units.) *Richardson*

**236. Roman Painting.** Roman pictorial art with concentration on the wall paintings from Campania. Investigation of techniques, iconography, and the use of pictures in decoration. One course. (3 graduate units.) *Richardson*

### For Graduates

(One course is offered each year.)

**311. Archeology Seminar I.** 3 units. *Stanley*

**312. Archeology Seminar II.** 3 units.

Under the terms of a cooperative agreement, graduate students of Duke University may, with approval of the chairman of their major department and upon payment of a nominal fee, take any graduate course offered by the Department of Classics of the University of North Carolina. A list of these courses will be sent upon request.

## Comparative Literature

No graduate degree is offered in comparative literature. The following courses may serve, however, in the minor programs of students in other departments. Consult Professor Wardropper in the Department of Romance Languages.

**201, 202. Romanticism.** Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany, with some reference to other countries. Selected subjects will occasionally be covered by speakers from various departments of the University. Two courses. (6 graduate units.)

**203, 204. Realism and Symbolism.** Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. Two courses. (6 graduate units.)

**205. The Modern: Problems of Definition, History, and Language.** The self-consciousness of literature in the "age of criticism." Representative twentieth century texts discussed as authorial confrontations with normative modern masters (Baudelaire, Flaubert, Rimbaud, Dostoevsky, Nietzsche). One course. (3 graduate units.) *Rolleston*

**206. Autobiography.** Origins and developments in the chief European literatures including autobiographies of St. Augustine, Montaigne, Bunyan, Rousseau, Goethe, Carlyle, Nietzsche, Yeats, and Jung. One course. (3 graduate units.) *Clubbe*



**220S. Comparative Literature Seminar.** Topics vary. One course. (3 graduate units.) *Jantz*

**223. Structuralism and the New Criticism.** (Also listed as French 223.) One course. (3 graduate units.) *Fowlie*

**285. Literary Criticism.** (Also listed as English 285.) One course. (3 graduate units.)

**301. The Hero in European Fiction, 1830-1940.** Studies in the "loss of self" from Balzac to Robert Musil. Intended primarily for minors in comparative literature. Prerequisite: consent of instructor. 3 units.

## Computer Science

Professor Loveland, *Chairman* (202 Computation Center); Assistant Professor Gerhart, *Director of Graduate Studies* (201 Computation Center); Professors Gallie, Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond Patrick, and Starmer; Assistant Professors Biermann, Foster, Ramm, and Trivedi; Adjunct Associate Professor Williams

The Department of Computer Science offers programs leading to the A.M. and Ph.D. degrees.

A student entering graduate work in computer science should have a knowledge of mathematics through advanced calculus and of at least two computer programming languages. Research interests of present faculty include mathematical foundations of computer science, artificial intelligence, program verification, programming, languages, real-time computing, operating systems, information storage and retrieval, computer design, simulation of systems of interest to social scientists, and numerical analysis.

### For Seniors and Graduates

**200. Programming Methodology.** Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 150 and 152. One course. (3 graduate units.) *Gerhart*

**201. Programming Languages.** Information binding, data structures and storage, control structures, recursion, execution environments, input/output; syntax and semantics of languages; study of PL/I, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA; exercises in programming. Prerequisite: Computer Science 200. One course. (3 graduate units.) *Gerhart*

**203. Random Signals and Noise.** (Also listed as Electrical Engineering 203.) One course. (3 graduate units.) *Kerr or Nolte*

**205. Signal Detection and Extraction Theory.** (Also listed as Electrical Engineering 205.) One course. (3 graduate units.) *Nolte*

**208. Digital Computer Design.** (Also listed as Electrical Engineering 208.) One course. (3 graduate units.) *Marinos or Owen*

**210. Image Processing.** Digital image transducers and processing algorithms; special purpose filters and tracking algorithms as applied to both binary and multi-gray level images; transducer hardware such as flying spot scanners and image dissectors. One course. (3 graduate units.) *Starmer*

**215. Artificial Intelligence.** Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem-solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or consent of instructor. One course. (3 graduate units.) *Biermann*

**221. Numerical Analysis I.** Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of nonlinear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) One course. (3 graduate units.) *Gallie or Patrick*

**222. Numerical Analysis II.** Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) One course. (3 graduate units.) *Patrick or Utku*

**223. Numerical Optimization.** Numerical methods for finding minima of functions of several or many variables, with and without conditions of constraint. Prerequisite: Computer Science 221 or equivalent. One course. (3 graduate units.) *Staff*

**225. Mathematical Foundations of Computer Science I.** Introduction to basic concepts and techniques used in mathematical models of computation. Elements of the predicate calculus; applications to automatic theorem proving and verification of programs. Notions of computable sets, functions, algorithmically unsolvable problems. Regular and context-free formal languages and the machines that define them. Prerequisite: four semesters of college mathematics. One course. (3 graduate units.) *Loveland*

**226. Mathematical Foundations of Computer Science II.** Basic concepts and techniques used in the modeling of systems. Elements of probability, statistics, queuing theory, linear programming, linear systems, and error analysis. Prerequisites: four semesters of college mathematics. One course. (3 graduate units.) *Foster*

**231. Introduction to Operating Systems.** Characteristics and components of operating systems and methods for their implementation. Program linkage and relocation, job scheduling, resource allocation and interrupt handling, input/output control systems, on-line file structures, communication, time sharing and real time systems. Case studies of existing systems. Prerequisite: Computer Science 152. One course. (3 graduate units.) *Foster or Ramm*

**232. Metaprograms.** Programs which process programs: compilers, interpreters, and assemblers. Syntax and semantics of programming languages. One course. (3 graduate units.) *Gallie*

**241, 242. Information Organization and Retrieval.** Structure, analysis organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching procedures, indexing, file maintenance and methods for user interaction with the automated system. Programming experience included. Prerequisite: Computer Science 152. Two courses. (6 graduate units.) *Hammond*

**244. Computer Simulation Models of Economic Systems.** (Also listed as Economics 244.) One course. (3 graduate units.) *Naylor*

**250. Pattern Analysis, Clustering, and Typology.** Algorithms for clustering

and classification with special emphasis on graphical methods, clique enumeration. Discriminant analysis, finite mixtures estimation, and error analysis. Sequential methods for feature selection and for pattern learning. Typology (nosology) and formal diagnostics, learning (sequential estimation) of functional relations. Prerequisite: consent of instructor. One course. (3 graduate units.) *Woodbury*

**251. Computer Science for Teachers.** An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. Summer session. One course. (3 graduate units.) *Staff*

**265. Advanced Topics in Computer Science.** One course. (3 graduate units.) *Staff*

**301. Topics in Programming Theory.** Advanced topics in theory of programming will be selected from areas of current research. Prerequisites: Computer Science 201 or consent of instructor. 3 units. *Gerhart*

**306. Adaptive Detection and Communication Systems.** See course description for Electrical Engineering 306. (Also listed as Electrical Engineering 306.) 3 units. *Nolte*

**307. Advanced Digital Systems I.** See course description for Electrical Engineering 307. (Also listed as Electrical Engineering 307.) 3 units. *Marinos*

**308. Advanced Digital Systems II.** See course description for Electrical Engineering 308. (Also listed as Electrical Engineering 308.) 3 units. *Marinos*

**311. Inverse Models.** See course description for Biomedical Engineering 311. (Also listed as Biomedical Engineering 311.) 3 units. *Pilkington*

**315. Advanced Artificial Intelligence.** Course content will vary from year to year and will include a detailed study of one or more of the following: mechanical theorem proving, natural language processing, automatic program synthesis, machine learning and inference representation of knowledge, languages for artificial intelligence research, artificial sensorimotor systems, and others. Prerequisite: Computer Science 215. 3 units. *Biermann*

**321. Topics in Numerical Mathematics.** Advanced topics in numerical mathematics to be selected from areas of current research. Prerequisites: Computer Science 221 and 222 or 223. 3 units. *Gallie or Patrick*

**325. Theory of Computation.** Elements of recursive function theory: s-m-n theorem, recursion theorem. Abstract computational complexity: essentially complex functions, Blum speed-up theorem. Concrete complexity and analysis of algorithms, e.g., matrix multiplication. Subrecursive hierarchies: the deterministic and non-deterministic polynomial bound hierarchies. Program schemata. Techniques for proving properties of programs. Emphasis among above topics will vary from year to year. Prerequisite: computer Science 225 or equivalent. 3 units. *Loveland*

**326. Systems Modeling.** Advanced study of analytical models of systems; queuing model and its parameterization and validation. Methods for computer solutions of some models. Prerequisites: Computer Science 226 and 231. 3 units. *Foster or Trivedi*

**331. Operating Systems Theory.** Advanced study of theoretical aspects of operating systems emphasizing models and control of concurrent processes,

processor scheduling and memory management. Prerequisites: Computer Science 226 and 231. 3 units. *Foster or Trivedi*

**332. Topics in Operating Systems.** Advanced topics in operating systems to be selected from areas of current research. Prerequisite: Computer Science 331. 3 units. *Foster or Trivedi*

**344. Workshop on Computer Models of Social Systems.** See course description for Economics 344. (Also listed as Economics 344 and Political Science 344.) 3 units. *Naylor*

**350. Advanced Engineering Analysis.** See course description for Civil Engineering 350. (Also listed as Civil Engineering 350.) 3 units. *Utku*

## Economics

Professor Kelley, *Chairman* (215-A Social Science); Associate Professor Weintraub, *Director of Graduate Studies* (315 Social Science); Professors Blackburn, Bronfenbrenner, Davies, Goodwin, Kreps, Lewis, Naylor, Saville, Trembl, Vernon, Wallace, and Yohe; Associate Professors de Marchi, Grabowski, Graham, Havrilesky, and Tower; Assistant Professors Bolnick, McElroy, and Wyse

The Department of Economics offers graduate work leading to the A.M. and Ph.D. degrees. Among the undergraduate courses of distinct advantage to the graduate student in economics are general accounting, elementary statistics, intermediate economic theory, money and banking, international trade, and basic courses in philosophy, mathematics, and social sciences other than economics. Advanced work in mathematics or statistics is also useful.

Requirements for the Ph.D. degree in economics include examination in economic theory at the end of the first year, and, at the end of the second year, an examination in economic analysis. In addition, a student must obtain certification in three fields, one of which may be in an outside minor. The student may select from advanced economic theory, history of political economy, economic development, economic history, international economics, money and banking, labor economics, public finance, industrial organization, econometrics, statistics, Soviet economics, and certain fields outside the economics department (e.g., demography). Course work for the Ph.D. degree should be completed in four semesters of residence.

### For Seniors and Graduates

**200. Capitalism and Socialism.** Selected ideological classics of new and old right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. Prerequisite: Economics 149 or 154, or consent of instructor. One course. (3 graduate units.) *Bronfenbrenner*

**204S. Advanced Money and Banking.** Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. One course. (3 graduate units.) *Havrilesky or Yohe*

**231S. Economic Development of Europe.** Sequence of local, national, and international economic structures under situations of changing trade, industry, agriculture, population, investment, war conditions, public ownership, cartels, colonialism, and prices. One course. (3 graduate units.) *Saville*



**232. Economic History of Japan.** Japanese economic development, stressing the period since the end of isolation. Prerequisite: one semester of economic analysis or of Far Eastern history. (Also listed as History 260.) One course. (3 graduate units.) *Bronfenbrenner*

**\*233. State and Urban Finance.** Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local governments. One course. (3 graduate units.) *Davies or Wyse*

**237, 238. Statistical Methods.** A study of statistical methods appropriate for dealing with problems in business and social science. In addition to developing more thoroughly the subject considered in business statistics, the following methods will be considered: simple, multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of instructor. Two courses. (6 graduate units.) *Staff*

**243. Econometrics I.** Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of simultaneous equations. Use is made of the electronic computer. One course. (3 graduate units.) *Naylor or Wallace*

**244. Computer Simulation Models of Economic Systems.** A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates, computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design. (Also listed as Computer Science 244.) One course. (3 graduate units.) *Naylor*

**245. Econometrics II.** Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making, simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course. Prerequisite: Economics 243. One course. (3 graduate units.) *McElroy or Wallace*

**262. Trade Unionism and Collective Bargaining.** An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. One course. (3 graduate units.) *Staff*

**265S. International Trade and Finance.** A study of fundamental principles of international economic relations. Subjects covered include the economic basis for international specialization and trade, and the economic gains from trade, the balance of international payments, problems of international finance, investments, and monetary problems. Prerequisite: Economics 149. One course. (3 graduate units.) *Bronfenbrenner or Tower*

**287. Public Finance.** Economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor as well as other public policies and questions. One course. (3 graduate units.) *Davies*

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\*Offered on demand.

**293. Soviet Economic History.** Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. One course. (3 graduate units.) *Trembl*

**294S. Soviet Economic System.** Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal microdecision-making in a nonmarket economy. One course. (3 graduate units.) *Trembl*

**301. Microeconomic Analysis I.** Review of contemporary theory relating to production, the firm, and income distribution in competitive and imperfectly competitive markets. 3 units. *Graham*

**302. Microeconomic Analysis II.** A continuation of Economics 301 with emphasis on analyses of consumer behavior, general equilibrium, welfare economics, and capital theory. Prerequisite: Economics 301. 3 units. *McElroy or Weintraub*

**303. Theory of Economic Decision-Making.** The extension of economic theory to the allocation of resources within firms and governmental units. Prerequisite: Economics 301 or its equivalent. 3 units. *Staff*

**304, 305. Monetary Theory and Policy.** In the first semester: theories of the supply of and demand for money (neoclassical and Keynesian macroeconomic), general equilibrium theories, and theories of the term structure of interest rates. In the second semester: the theory and practice of the monetary policy with emphasis on recent issues, the monetarist-fiscalist controversy, the monetary policy transmission mechanism, and policy simulations with econometric models. 3 units per semester. *Havrilesky or Yohe*

**307. Quantitative Analysis I.** A systematic analysis of the principal quantitative methods used in microeconomic theory. Neoclassical theories of production and distribution are used as vehicles for presenting the material. Considerable emphasis is placed on the application of mathematical analysis to economic models. 3 units. *McElroy*

**308. Quantitative Analysis II.** Linear economic models, particularly Leontief models, are used in the exposition. Primary emphasis is placed on the application of mathematics to economic theory. Prerequisite: Economics 307 or consent of instructor. 3 units. *Graham*

**311, 312. History of Political Economy.** A detailed review of the development of economic theory, the tools of economic analysis, and economics as a science, together with an analysis of the circumstances affecting this development. Period covered: pre-Christian times through 1936. 3 units per semester. *Goodwin*

**313, 314. Seminar in Economic Theory.** Prerequisite: Economics 301 or its equivalent. 3 units per semester. *Weintraub*

**316. Seminar in Economics of Soviet-Type Socialism.** Selected topics in analysis of theoretical and institutional framework of Soviet economic system, such as markets versus plan, optimizing techniques in planning, price determination, balanced economic development, and ideology and economic policy. 3 units. *Trembl*

**317. Seminar in Demographic, Population, and Resource Problems.** 3 units. *Kelley*

**318. Dissertation Seminar.** 3 units. *Staff*

**319. Seminar in the Theory and the Problems of Economic Growth and Change.** 3 units. *Staff*

**320. Macroeconomic Analysis I.** Measurement of national income and other important aggregates; classical macroeconomics; Keynesian and more recent views of the determinants of income, employment, and price levels; empirical studies of consumption, investment, and monetary variables. 3 units. *Bronfenbrenner*

**321. Theory of Quantitative Economic Policy.** The use of mathematical models in analyzing the connections between means and ends of economic policy; topics covered include principles and design, centralization and decentralization, stabilization and growth policies, welfare optimization, imperfect models, and the use of control system analysis. Prerequisite: Economics 320. 3 units. *Staff*

**322. Macroeconomic Analysis II.** Further analysis of topics treated in Economics 320. Optimal economic growth; business cycles. Issues in economic policy. Prerequisite: Economics 320. 3 units. *Graham or Weintraub*

**323. Income Distribution Theory.** Income distributions—functional and personal. Concepts and measures of poverty and inequality. Maldistribution issues—ethical and economic. Pricing of productive services, primary attention on wages and employment. Rival aggregative (macro distribution) theories. Prerequisites: intermediate micro- and macro-economics and some knowledge of calculus and statistics. *Bronfenbrenner*

**329. Federal Finance.** An analysis of the trends and hypotheses concerning the growth in governmental activity, the optimum level and composition of governmental spending, and the microeconomic and macroeconomic effects of governmental spending and tax policies. 3 units. *Davies*

**330. Seminar in Public Finance.** 3 units. *Wyse*

**331. Seminar in Economic History.** 3 units. *Staff*

**344. Workshop on Computer Models of Social Systems.** A course on the methodology of constructing computer simulation models of social systems including political, economic, social, administrative, and educational. Although the emphasis of the course is on a variety of different types of models of social systems, special consideration is given to the methodology of designing simulation experiments. (Also listed as Computer Science 344, Political Science 344 and Sociology 344.) 3 units. *Naylor*

**345, 346. Demographic Techniques I and II.** (Also listed as Sociology 345, 346.) 3 units each semester. *Myers*

**350. Seminar in Applied Economics.** A course that will use the principles of micro-economics in the analysis of problems and policies. The particular contextual materials that will be subjected to analysis will vary from time to time. Materials will be treated in the tradition of positive economics.

**355. Seminar in Labor Economics.** 3 units.

**358. Seminar in Labor Market and Related Analysis.** 3 units. *Staff*

**365. Seminar in International Economics.** 3 units. *Tower*

**366. Monetary Aspects of International Trade and Finance.** The monetary, as opposed to the pure, side of international economics. Among the topics considered are the balance of payments, the foreign-exchange market capital

movements, payments equilibrium, the demand for reserves, and international monetary reform. 3 units. *Tower*

**\*388. Industrial Organization.** The theory, measurement, and history of the firm-structure of industry. Emphasis upon the structure of American industry and upon actual production and pricing practices. Criteria for evaluating industrial performance. 3 units. *Vernon or Grabowski*

**\*389. Seminar in Industrial and Governmental Problems.** 3 units. *Vernon*  
**397, 398. Directed Research.**

**401. Seminar on the British Commonwealth.** 3 units. *Ball, Preston, and Others of the Committee on Commonwealth Studies*

**402. Interdisciplinary Seminar in the History of the Social Sciences.** 3 units. *Goodwin, Holley, and Spragens*

### **Related Courses in Other Departments**

Courses in related fields may be selected from anthropology, computer science, forestry, history, mathematics, philosophy, political science, and sociology, or from an area that complements the candidate's area of research interests in economics.

See Program in Comparative Studies on Southern Asia and the Center for Demographic Studies in the chapter on Special and Cooperative Programs for further information.

## **Education**

Professor Flowers, *Chairman* (213 West Duke Building); Professor Petty, *Director of Graduate Studies* (205 West Duke Building and 116 Allen Building); Professors Adams, Cartwright, S. Gehman, Githens, Hopkins, Hurlburt, Katzenmeyer, Shuman, and Weitz; Associate Professors Ballantyne, Carbone, Colver, Davis, Di Bona, Johnson, Martin, and Pittillo; Lecturers Fowler, I. Gehman, and Leach

Graduate work in education is offered leading to the A.M., the M.Ed., the M.A.T., the Ed.D., and the Ph.D. degrees. For each of these degrees there are specific requirements and prerequisites, all of which may be found stated in detail in this *Bulletin*. Departmental requirements and prerequisites for all of these degrees may be obtained from the Director of Graduate Studies.

From the courses listed below, plus several in related disciplines, a selection may be made which will meet North Carolina requirements for the Advanced Principal's Certificate, the Superintendent's Certificate, and the Supervisor's Certificate.

(Some courses below are offered only in the summer session; see the *Bulletin of the Summer Session*.)

The programs are accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers and school service personnel with the doctor's degree as the highest degree approved.

### **For Seniors and Graduates**

**201. Mathematics Program in the Elementary School.** Objectives, curriculum, and instructional strategies. One course. (3 graduate units.) *Petty*

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\*Offered on demand.



**202. Comparative and International Education: Industrialized Nations.** Structure and functioning of educational institutions in selected developed societies. Relevant social science theory and methods. One course. (3 graduate units.) *Di Bona*

**203. Seminar in Philosophical Analysis of Educational Concepts.** Selected writings of contemporary philosophers; emphasis on such educational concepts as teaching, learning, knowing, understanding, indoctrination, explanation, and education. One course. (3 graduate units.) *Carbone*

**204. Educational Organization.** Theory and research on the processes of exchange between educational organizations and their external environments; influence organizational structure, goals, and practices. Examining schools, colleges, and universities through a comparative approach with other forms of social organizations: hospitals, businesses, and prisons. One course. (3 graduate units.) *Martin*

**206. Studies in the History of Educational Philosophy.** The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course. (3 graduate units.) *Carbone*

**207. Social History of Twentieth Century American Education.** Twentieth century American education in context of social and intellectual history. One course. (3 graduate units.) *Johnson*

**209S. John Dewey.** Dewey's major writings with emphasis on his philosophy of education. One course. (3 graduate units.) *Carbone*

**210. The Politics of Education.** (Also listed as Political Science 210.) One course. (3 graduate units.) *Leach*

**213. Elementary School Organization and Administration.** Nursery school, kindergarten, and the elementary school. Problems of internal organization and management of elementary school and its integration with secondary school. One course. (3 graduate units.) *Flowers, Petty, or Pittillo*

**215S. Secondary Education: Principles.** Principles, curriculum, and methods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. One course. (3 graduate units.) *Cartwright, Githens, or Shuman*

**216. Secondary Education: Internship.** Supervised internship in junior and senior high schools. Full time for half a semester. One and one half courses. (6 graduate units.) *Cartwright, Githens, or Shuman*

**217. The Psychological Principles of Education.** Advanced study of teaching, learning, and the learner. One course. (3 graduate units.) *Davis, Gehman, or Weitz*

**218. Comparative and International Education: Developing Societies.** One course. (3 graduate units.) *Di Bona*

**219. Comparative and International Education: South Asia.** Traditional and modern educational developments in India and Pakistan. One course. (3 graduate units.) *Di Bona*

**221. Programs in Early Childhood Education.** Objectives and philosophy underlying programs in early childhood education. One course. (3 graduate units.) *Staff*

**222. New Developments in Elementary School Curriculum.** One course. (3 graduate units.) *Staff*

**223. Teaching the Language Arts.** Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. One course. (3 graduate units.) *Adams*

**224. Teaching the Social Studies in Elementary Schools.** One course. (3 graduate units.)

**225. The Teaching of History and the Social Studies.** Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. (3 graduate units.) *Cartwright*

**226. Teaching Developmental and Remedial Reading in the Elementary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course. (3 graduate units.) *Adams*

**227. The Teaching of Geography.** One course. (3 graduate units.)

**229. Assessments of Reading Disability Cases.** Standardized tests, other methods, and informal procedures used in diagnosing reading problems of elementary and secondary pupils. One course. (3 graduate units.) *Adams*

**232. Psycho-educational Counseling with Parents.** Individual and group counseling concerning psycho-educational problems of parents and children. Prerequisite: consent of instructor. One course. (3 graduate units.) *Ballantyne, Davis, or S. Gehman*

**233. Improvement of Instruction in English.** Recent developments and research techniques in the teaching of English through individual projects. Prerequisite: consent of instructor. One course. (3 graduate units.) *Shuman*

**234. Secondary School Organization and Administration.** Objectives and philosophy underlying the organization and administration of the secondary school. One course. (3 graduate units.) *Flowers*

**236. Teaching Developmental and Remedial Reading in the Secondary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course. (3 graduate units.) *Adams*

**237. Teaching of Literature in Secondary Schools.** Conventional, adult, and transitional literature is considered. One course. (3 graduate units.) *Shuman*

**238. Content, Supervision, and Administration of Reading Programs.** Objectives, organization, attributes, and evaluation of reading programs. One course. (3 graduate units.) *Adams*

**239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School.** Recent developments. One course. (3 graduate units.) *Shuman*

**240. Career Development.** Analysis of the world of work; socio-personal factors affecting occupational choice; theories of career developments; use of occupational and educational resources. One course. (3 graduate units.) *Ballantyne*

**241. Foundations of Counseling and Personnel Services.** Scope, principles, historical background, services, trends, and issues of counseling, and pupil personnel services. One course. (3 graduate units.) *Ballantyne or Colver*

**243. Personality Dynamics.** Personality structure and dynamics emphasizing implications for counseling and instruction. Prerequisite: six units of psychology or educational psychology. One course. (3 graduate units.) *S. Gehman*

**244. Counseling Techniques.** Individual counseling techniques; diagnosis, interviewing, program planning and counseling evaluation. Prerequisites: Education 243 and 258 or equivalent, which may be taken concurrently. One course. (3 graduate units.) *S. Gehman*

**245. Theories of Counseling.** One course. (3 graduate units.) *Weitz*

**246. Teaching of Mathematics.** Aims, curriculum, and classroom procedure for teaching secondary school mathematics. One course. (3 graduate units.)

**247. Practicum in Guidance and Counseling.** Local field experience in counseling and guidance program. Minimum of 150 hours of case work and supervision. Prerequisites: Education 244 and consent of instructor. One course. (3 graduate units per semester.) (May be repeated.) *Ballantyne, Colver, Gehman, or Weitz*

**248. Practicum in Counseling.** Individual counseling; test administration, intake interviewing, diagnosis, program planning, report preparation and evaluation. Minimum of 150 hours of case work and conferences with the supervisor. Prerequisite: consent of instructor. One course. (3 graduate units per semester.) (May be repeated.) *Ballantyne, Gehman, or Weitz*

**249. Exceptional Children.** Survey of major categories of exceptional children: mentally retarded, emotionally disturbed, brain injured, learning disabled, physically handicapped, visual and auditory deficient, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment. One course. (3 graduate units.) *Davis*

**250, 251. Teaching Emotionally Disturbed Children: Internship.** Basic principles and practices in teaching and organization of instructional materials. Work with children under supervision of a certified teacher of emotionally disturbed children. Experience in general classroom, small group, and individualized instruction. Participation in staff conferences with psychiatrists, psychologists, social case workers, and professional educators. Two courses. (3 graduate units per semester.) *S. Gehman*

**253. Introduction to Law and Education.** Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course. (3 graduate units.) *Martin*

**254. Law and Higher Education.** Concepts and procedures relating to higher education. Emphasis upon court decisions. Prerequisite: Education 253 or consent of instructor. One course. (3 graduate units.) *Flowers*

**255. Assessment of Abilities.** The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences including surveys of standardized tests of aptitude and achievement. One course. (3 graduate units.) *Colver*

**256. Classroom Assessment of Student Achievement.** The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course. (3 graduate units.) *Colver*

**258. Assessment of Personality, Interests, and Attitudes.** Rationale, construction, use, and interpretation of standardized instruments designed for the assessment of students' interests, attitudes, and personalities. Emphasis on counseling applications. Prerequisites: Education 243 and 255 or consent of instructor. One course. (3 graduate units.) *Colver or Weitz*

**259. Problems in Law and Education.** Current issues; researching of cases,

constitutional decisions, and statutes. Prerequisite: Education 253 or consent of instructor. One course. (3 graduate units.) *Flowers, Martin, or Pittillo*

**260. Educational Research I.** Research design, univariate quantitative methods, and applications of the computer to research problems. One course. (3 graduate units.) *Katzenmeyer*

**261. Educational Research II.** Analysis of covariance and multiple regression, discriminant function analysis, computer applications in research. Prerequisite: Education 260 or its equivalent. One course. (3 graduate units.) *Katzenmeyer*

**262. Educational Research III.** Multivariate analysis of variance, factor analysis, cluster analysis, and path analysis. Education 262 is offered only in a block with Education 261. One course. (3 graduate units.) *Katzenmeyer*

**266. Basic Science for Teachers.** Natural and physical science through selected readings, the use of experiments and demonstrations, construction and use of equipment, and field studies. One course. (3 graduate units.) *Githens*

**268. Seminar in Contemporary Educational Criticism.** One course. (3 graduate units.) *Carbone, Di Bona, Johnson, or Martin*

**270. Junior and Community College.** History, philosophy, and roles. Introductory course for future teachers, counselors, or administrators in a two-year college. One course. (3 graduate units.) *Hopkins or Hurlburt*

**271. Teaching in the Junior and Community Colleges.** Special attention to alternative systems, and the individualization of instruction for a heterogeneous student population. One course. (3 graduate units.) *Hopkins*

**272. Teaching Communication Skills in Early Childhood Education.** From birth to age eight with emphasis on reading readiness and language growth. One course. (3 graduate units.) *Adams*

**273, 274. Clinical Reading Practicum.** Experiences in the diagnosis and correction of reading disabilities in elementary and secondary students. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Adams*

**276. The Teaching of High School Science.** Discussion, lectures, and collateral reading related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary-school science. One course. (3 graduate units.) *Githens*

**285. Audiovisual Aids in Education.** Aims and psychological bases of audiovisual materials in the classroom. Offered in summer only. One course. (3 graduate units.) *Staff*

**291. Public and Community Relations of Schools.** One course. (3 graduate units.) *Hurlburt*

## For Graduates

**300. Individual Assessment of Intelligence.** Individual intelligence as measured by standardized individual instruments, chiefly the Wechsler Intelligence Test for Children and the Stanford-Binet L-M. Theory, administration, scoring, analysis, interpretation, and reporting. Work with children in supervised school settings. Prerequisite: consent of instructor. 3 units. *Davis*

**301. Advanced Individual Assessment of Cognitive Abilities.** Development of advanced understanding and skills in the use of clinical instruments for assessment of cognitive abilities. Analysis, interpretation, and consultation



about individual assessment. Supervised experience involving collaboration with children, school personnel, parents, and clinic and community representatives. Prerequisites: Education 300, or equivalent, and consent of instructor. 3 units. *Davis or S. Gehman*

**302. Seminar in Educational Research.** The seminar is primarily for students working on dissertations and theses. Special topics are considered as appropriate to the research designs developed. Prerequisite: Education 260 or 261. 3 units. *Katzenmeyer*

**303. Diagnostic and Educational Programs in Learning Disabilities.** Diagnostic, intervention, and remediation strategies and program development for the child with learning disabilities; review of major works in this field. Prerequisite: consent of instructor. 3 units. *Davis or S. Gehman*

**304. Internship in School Psychology.** Supervised internship in school psychology, utilizing principles and practices in an approved internship site. May be repeated. By consent of instructor. 3 units. *Davis*

**309. Seminar on Higher Education in the United States.** Major trends, issues, problems, new developments, and future prospects for higher educational institutions (excluding the junior/community college) in the United States. 3 units. *Flowers*

**310. Seminar in Higher Educational Administration.** New developments in the organization and administration of higher educational institutions, with special attention to administrative and organizational systems, management information systems, managerial accountability, and strategies for continuous planning and institutional renewal. 3 units. *Hopkins*

**311. Group Counseling.** Theories and techniques of counseling for small groups of children, adolescents, teachers, parents, and other adults. Simulated practice through recorded interviews and transcribed counseling sessions. Prerequisites: Education 244 and Education 245. 3 units. *S. Gehman*

**313. Seminar in Education and Public Policy.** The relationship of educational administration to the public policy process. (Also listed as Political Science 313.) 3 units. *Leach or Pittillo*

**314. Seminar in Guidance and Counseling.** Research, writing, and reporting on selected problems in the field of guidance and counseling. 3 units. *Weitz*

**315. Seminar in Secondary School Teaching.** Advanced-level consideration of principles, practices, and problems in secondary school instruction. Designed particularly to accompany an internship. For students without previous internship credit, this course must be accompanied by Education 216. 3 units. *Carbone or Hurlburt*

**316, 317. Practicum in Higher Educational Research and Development.** Review of the purposes and essential stages of research and development in higher education, followed by individual projects covering problem-identification, literature searches related to the problem, development of product specifications and design, and pilot testing of prototype product. 3 units per semester. *Hopkins*

**321. Educational Management.** Theory and practice of management as applied to education. For anyone who has or is preparing to have major management responsibilities in the field of education. 3 units. *Pittillo*

**322. Planning and Management of Educational Facilities.** For teachers, administrators, and supervisors. 3 units. *Pittillo*

- 323. Public School Finance.** Educational costs, sources of revenue for the support of public education, collection of revenue, basis of distribution, and accounting for funds spent. 3 units. *Pittillo*
- 326. Educational Psychology: The Problem Child.** Problem behavior and adjustment in children with emphasis on the causes and treatment of conduct and neurotic disorders of the maladjusted child. Particular attention will be paid to mental hygiene principles in the handling of problem children in school and home. 3 unit. *I. Gehman*
- 332. Supervision of Instruction.** The nature of supervision, underlying principles, and techniques of working with individual teachers and with groups. 3 units. *Hurlburt*
- 335, 336. Seminar in School Administration.** Organization and control over public education. First semester: attention to governance of education as exercised by the different branches and levels of government. Second semester: administrative organization. 3 units per semester. *Flowers, Hurlburt, Petty, or Pittillo*
- 337. Seminar in Community College Organization.** The nature, function, and organization of community colleges. Research, writing, and reporting on selected problems. 3 units. *Hurlburt*
- 338. Seminar in Educational Supervision.** Prerequisite Education 332 or its equivalent. 3 units. *Hurlburt*
- 339. Seminar in Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 340. Seminar in Social Studies Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 341. Seminar in Elementary School Curriculum.** Research, writing, and reporting on selected problems. 3 units.
- 342. Seminar in Secondary School Curriculum.** Research, writing, and reporting on selected problems. 3 units. *Cartwright*
- 343. History of Higher Education in America.** The growth and development of higher education in the United States from 1636 to the present. 3 units. *Staff*
- 344. Research in Higher Education.** Review of theory, practice, and contribution of research as an aid in understanding the functioning of institutions of higher education. 3 units. *Hopkins*
- 345. Seminar in Reading Instruction and Research.** Major problem areas in contemporary reading instruction, with emphasis on theoretical, historical, and philosophical contributions to the formulation of objectives and methodologies in modern reading instruction. 3 units. *Adams*
- 346. Seminar in Organization of Pre-Service and In-Service Reading Programs.** Theories, content, and instructional strategies for teaching reading and other language arts courses in university and in-service courses. 3 units. *Adams*
- 347. Student Personnel Service in Higher Education.** Basic objectives of student personnel services in post-secondary education and the administrative procedure developed to achieve these objectives. 3 units. *Colver*
- 348, 349. Seminar in Child Psychopathology.** Under the direction of a child psychiatrist, the student will select one elementary school age child for a psychoanalytic study of neurotic conflicts, unconscious motivations, dream work,

defense mechanisms, and transference phenomena. Prerequisite: consent of instructor. 3 units. *Fowler*

**350, 351. Directed Activities in Education.** Internship experiences at an advanced level under supervision of appropriate staff. Consent of instructor. 3 units per semester. *Staff*

**360. Seminar on Instructional Strategies.** Relationships among the broad purposes of education, the process and product objectives, and strategies employed to achieve those purposes and objectives. A synthesis among the purpose, objectives, and strategies is sought. 3 units. *Katzenmeyer*

## Engineering

Aleksandar Sedmak Vesić, D.Sc., *Dean* (136 Engineering)

The School of Engineering offers programs of study and research leading to the degrees of Master of Science and Doctor of Philosophy with a major in biomedical, civil, electrical, or mechanical engineering. These programs are designed to provide a fundamental understanding of the engineering sciences, which are based on mathematics and the physical sciences, and to develop experience in the art of engineering, which includes strong elements of intuition, imagination, and judgment. Each engineering graduate student may participate in seminars appropriate to his field of study.

A *minimum* of 30 units of earned graduate credit beyond the bachelor's degree is required for the M.S. degree: 12 in the major, 6 in related minor work (usually mathematics or natural science), 6 in either the major or minor subject or in other areas approved by the major department, and 6 for a research-based thesis. A non-thesis option requiring 30 units of course credit is available. Each of the departments imposes additional requirements in the exercise of this option. There is no language requirement for this degree.

A *minimum* of 60 units of earned graduate credit beyond the bachelor's degree is required for the Ph.D. degree in biomedical, civil, and electrical engineering, 24 in the major, 12 in related minor work (often mathematics or natural science), 12 in either the major or minor subject or other areas approved by the major department and the Dean of the School of Engineering, and 12 for a research-based dissertation. In mechanical engineering there are no overall course requirements; each program is planned to meet individual needs. The directors of graduate studies will, during the first period of full-time registration of each doctoral aspirant, appoint a program advisory committee consisting of three members of the graduate faculty in areas relevant to the student's intended major. The preliminary examination may be either written, oral, or a combination of written and oral components, at the discretion of the committee and the department.

## BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman*; Professor Thurstone, *Director of Graduate Studies*; Professor Clark, McElhaney, Nolte, Wolbarsht; Associate Professors Barr, Evans, Hammond, and Wachtel; Assistant Professors Tolley and von Ramm

Biomedical engineering is often defined as the application of the concepts and methods of the physical, mathematical, and engineering sciences to biology and medicine. The definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the graduate program in biomedical engineering is to encourage the optimum combining of engineering and biomedical course work with an interdisciplinary research topic so that the graduates of this program



can contribute at the most advanced professional level to the interdisciplinary field of biomedical engineering. The major research areas available include: biomechanics, biomedical materials; biomedical modeling; data acquisition and processing; and electrophysiology.

**201. Analysis of Bioelectric Phenomena.** Fundamentals of bioelectric modeling with particular emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. One course. (3 graduate units.) *Wachtel*

**202. Energy and Rate in Biological Processes.** An introduction to biomedical thermodynamics and transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had Biomedical Engineering 172. One course. (3 graduate units.) *Clark*

**203. Bioelectric Potentials and Field Theory.** A study of bioelectric potentials and models for their generation. Analysis from a field theoretic point of view with particular emphasis on formulations that are amenable to computation. One course. (3 graduate units.) *Pilkington*

**204. Real Time Measurement and Control of Heart Events.** Specification of procedures and devices from biological considerations, and their design and construction. Consideration of amplifiers, analog-digital conversion, computer interfaces, and associated programming. Evaluation of selected examples for accuracy, complexity, and cost. One course. (3 graduate units.) *Barr*

**207. Experimental Mechanics.** Experimental studies and techniques basic to mechanics, stress-strain measurements and transducers, dynamic force, acceleration and flow measurements and analysis, viscoelastic behavior and modeling, high speed photographic methods, general applications to biomechanics including gait and analysis, head injury, automotive safety criteria, and blood flow. One course. (3 graduate units.) *McElhancy*

**223. Biomedical Materials and Artificial Organs.** The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. One course. (3 graduate units.) *Clark*

**225. Mechanics of Cellular Components.** Concepts of solid, semi-solid, and liquid mechanics applied to the study of cell components, e.g., membranes, cytoplasm, organelles, nuclei, etc. Transition from molecular structure to continuum properties will be emphasized. Prerequisite: consent of instructor. One course. (3 graduate units.) *Evans*

**230. Biomechanics.** Kinematic models of human motions, mechanical properties of bone and soft tissues, hydrodynamics of micturition, load directed growth mechanisms, human tolerance to impact and vibration, head injury criteria applied to helmet design. Prerequisite: consent of instructor. One course. (3 graduate units.) *McElhane*y

**233. Discrete Systems and Models of Computation.** Difference equations, numerical approximation, and digital filters with particular emphasis on developing constrained models that are both physically reasonable and amenable to computation. One course. (3 graduate units.) *Pilkington*



**241, 242. Information Organization and Retrieval.** (Also listed as Computer Science 241, 242.) Two courses. (6 graduate units.) *Hammond*

**243. Computers in Biomedical Engineering.** An in-depth study of the use of computers in biomedical applications. Hardware, software, and applications programming will be considered. Data collection, analysis, and presentation will be studied within application areas such as monitoring, medical records, computer-aided diagnoses, computer-aided instruction, MD-assistance programs, laboratory processing, wave form analysis, hospital information systems, and medical information systems. One course. (3 graduate units.) *Hammond*

**252. Marine Electrobiology.** The physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysiological studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. Ionic basis of bioelectric signals, transmission of signals within and between cells, relation of bioelectric signals to particular behavioral patterns, effects of externally applied electric fields, bioelectric communication and navigation systems. Prerequisites: consent of instructor. Summer at Beaufort. (Also listed as Physiology and Pharmacology 222.) One and one half courses. (6 graduate units.) *Wachtel and Wolbarsht*

**265. Advanced Topics in Biomedical Engineering.** Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Prerequisites: consent of chairman and instructor under whom the work will be done. One course. (1 to 4 graduate units.) *Staff*

**311. Inverse Models.** Analytical and computational methods for determining the internal state of a biological system from a set of external measurements and *a priori* characterization of the system. Particular emphasis is placed on the inherent limitations and difficulties encountered in obtaining numerical solutions from inverse formulations and the value of constraints in reducing these difficulties. (Also listed as Computer Science 311.) 3 units. *Pilkington*

**333. Biomedical Imaging.** A study of the fundamentals of information detection, processing, and presentation associated with imaging in biology and medicine. Analysis of coherent and incoherent radiation and various image generation techniques. Also covered will be the psychometrics of image evaluation dealing with subjective and objective parameters. Emphasis will be placed upon sonography, thermography, X-ray, various forms of nuclear radiography, microscopy, and holography. 3 units. *Thurstone*

**399. Special Readings in Biomedical Engineering.** Individual readings in advanced study and research areas of biomedical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units per semester. *Graduate Staff*

## CIVIL ENGINEERING

Professor Muga, *Chairman* (121 Engineering); Professor Dvorak, *Director of Graduate Studies* (126 Engineering); Professors Brown, Utku, and Vesic; Associate Professors Danjani, Palmer, Vesilind, and J. F. Wilson; Assistant Professor Tsui; Adjunct Professor Saibel; Adjunct Assistant Professor Warner; Lecturers Lathrop and Rimer

A student may specialize in one of the following fields of study for either the M.S. or the Ph.D. degree: environmental engineering; geotechnical engineering

and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources, and ocean engineering; structural engineering; and urban systems and transportation. Interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering are also available. In addition, there is a special program leading to the M.S. degree in civil engineering and the A.M. degree in public policy sciences.

With the approval of the department, a master's degree candidate in civil engineering may choose, in lieu of submitting a thesis, to complete an additional 6 units of course work plus a special project. If the candidate elects this alternative, he is expected to take a comprehensive examination over his graduate course work, and also to defend orally his special project.

Under the Reciprocal Agreement with Neighboring Universities, a student may include as a portion of the minimum requirements work offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. Although related work normally is taken in the natural sciences or mathematics, a student whose major interest relates to the social or managerial sciences may take relevant work in these areas.

A minimum prerequisite to the graduate program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics.

**201. Advanced Mechanics of Solids.** Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Corequisite: Mathematics 285 or equivalent. One course. (3 graduate units.) *Dvorak*

**204. Plates and Shells.** Differential equation and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and orthotropic material. Solution methods. Differential equation formulation of thin shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisites: Mathematics 104, and Engineering 75 or Engineering 135, or consent of instructor. One course. (3 graduate units.) *Utku*

**205. Elasticity.** Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending, and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: Civil Engineering 201 or equivalent. One course. (3 graduate units.) *Dvorak*

**206. Advanced Mechanics of Solids II.** Continuum theories for time-independent and time-dependent materials. Formulation and solution of boundary value problems; analytical and numerical techniques, applications. Prerequisite: Engineering 135, or Civil Engineering 201. One course. (3 graduate units.) *Dvorak*

**209. Structural Dynamics.** Vibration and stability (small and global) of discrete and continuous linear systems; introduction to nonlinear theory, parametric and random excitation. Applications include response studies of machines, ships, pipelines, bridges and buildings to man-made and nature-induced loadings. (Listed also as Mechanical Engineering 209.) One course. (3 graduate units.) *J. F. Wilson*

**210. Intermediate Dynamics.** (Also listed as Mechanical Engineering 210.) One course. (3 graduate units.) *Macduff or J. F. Wilson*

**212. Mechanical Behavior of Materials.** Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: Civil Engineering 201. One course. (3 graduate units.) *Dvorak*

**215. Urban and Regional Geography.** Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. One course. (3 graduate units.) *Dajani*

**216. Transportation Planning and Policy Analysis.** Issues in policy planning and decision-making in urban and rural transportation systems. Transportation legislation. Public transportation alternatives with emphasis on public transit and paratransit solutions. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. (Also listed as Public Policy Science 254.) One course. (3 graduate units.) *Dajani*

**217. Transportation Systems Analysis.** The transportation systems planning process. Quantitative analysis, mathematical modeling and computer simulation techniques for short and long-range planning and evaluation of transportation systems. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. One course. (3 graduate units.) *Dajani*

**218. Engineering-Economic Analysis.** Methods of analysis applicable to the economic evaluation of both pre-construction project plans and post-construction project outcomes. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation and comparisons of multiple alternatives. Concepts of welfare economics with regard to public works development. Identification and measurements of both monetary and non-monetary consequences of public works. Student projects involving the analysis and evaluation of public investments. One course. (3 graduate units.) *Dajani or Warner*

**221. Incompressible Fluid Flow.** Steady and unsteady pipe flow; theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluid systems; effect of resistance; tapered conductors. One course. (3 graduate units.) *Muga*

**222. Open Channel Flow.** Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. One course. (3 graduate units.) *Muga*

**223. Flow Through Porous Media.** Theory of miscible and immiscible fluid displacement processes. Derivation and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. One course. (3 graduate units.) *Muga*

**224. Coastal and Offshore Engineering.** Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave



spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. One course. (3 graduate units.) *Muga*

**225. Engineering Hydrology.** Study of processes governing the origin, distribution, and depletion and replenishment of water resources, and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometeorology, precipitation runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. One course. (3 graduate units.) *Muga*

**231. Structural Engineering Analysis.** The analysis of fundamental structural forms including arches, suspension cables and members of variable inertia. Influence lines for indeterminate structures. Introduction to matrix analysis. Prerequisites: Civil Engineering 131 and Mathematics 104, or consent of instructor. One course. (3 graduate units.) *Brown*

**232. Reinforced Concrete Design.** A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, and shear and diagonal tension. Two-way slab and flat plate design. Prerequisite: Civil Engineering 133. One course. (3 graduate units.) *Brown*

**233. Prestressed Concrete Design.** A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Prerequisite: Civil Engineering 133. One course. (3 graduate units.) *Brown*

**234. Structural Design in Metals.** Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: Civil Engineering 134. One course. (3 graduate units.) *Palmer*

**235. Foundation Engineering.** An introduction to methods of analysis, design, and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; and underpinning. Foundation vibrations. One course. (3 graduate units.) *Vesic*

**236. Earth Structures.** An introduction to methods of analysis, design, and construction of earth structures such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. One course. (3 graduate units.) *Tusi*

**238. Rock Mechanics.** Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock testing techniques. Prerequisite: Civil Engineering 139 or consent of instructor. One course. (3 graduate units.) *Staff*

**241. Environmental Engineering Chemistry and Biology.** Inorganic and organic chemistry as applied to water and wastewater treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectrophotometry, chromatography, and atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: Civil Engineering 124. One course. (3 graduate units.) *Vesilind*



**243, 244. Sanitary Engineering Unit Operations and Process Design.** Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. Prerequisite: Civil Engineering 124 or consent of instructor. Two courses. (6 graduate units.) *Vesilind*

**246. Sanitary Engineering Design.** The study of water resources and municipal water requirements including reservoirs, transmission, treatment and distribution systems; methods of collection, treatment and disposal of municipal and industrial wastewaters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and wastewater systems. Field trips to be arranged. Prerequisite: Civil Engineering 124 or consent of instructor. One course. (3 graduate units.) *Rimer and Vesilind*

**247. Air Pollution control.** The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. One course. (3 graduate units.) *Vesilind*

**248. Solid Waste and Resource Recovery Engineering.** Engineering design of resource recovery systems including traditional and advanced technologies. Sanitary landfills and incineration of solid wastes. Energy recovery and recycling municipal refuse. Collection, treatment, and disposal of solid wastes from wastewater treatment. Prerequisite: Civil Engineering 124 or consent of instructor. One course. (3 graduate units.) *Rimer and Vesilind*

**249. Resource Recovery Systems Management.** The social, economic, legal, political, and administrative aspects of resource recovery from municipal solid wastes. Economic applications and systems management. Assessment methodologies. Federal and state legislation. Public versus private sector interests. Policy issues. Case studies. Prerequisite: consent of instructor. One course. (3 graduate units.) *Dajani and Warner*

**250. Engineering Analysis.** Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem-solving techniques. One course. (3 graduate units.) *J. F. Wilson*

**251. Systematic Structural Analysis I.** Computer analysis techniques for the equilibrium problems of solids and structures. Describing the problems to a digital computer. Transformation matrices. Recapitulation of energy theorems. Stiffness and flexibility relations of structural elements in discrete space and continuum. Systematic analysis of equilibrium problems by displacement and force methods. Errors. Prerequisites: Mathematics 104, and Civil Engineering 131 or Engineering 135, or consent of instructor. One course. (3 graduate units.) *Utku*

**252. Systematic Structural Analysis II.** Computer analysis techniques for the equilibrium, eigenvalue and propagation problems of solids and structures. Representation of initial stresses. Handling of geometrical nonlinearities in equilibrium problems. Buckling. Handling of material nonlinearities. Incremental load techniques. Time dependent materials. Representation of inertial and damping forces. Stationary and transient vibrations. Random vibrations. Prerequisite: Civil Engineering 251 or consent of instructor. One course. (3 graduate units.) *Utku*

**306. Plasticity.** Mathematical theories of time-dependent inelastic material behavior and their experimental foundations. Yield conditions, flow and hard-

ening rules, unloading, shakedown. Theories of limit analysis. Slipline fields. Numerical methods. Applications to problems in the design of structures, metal forming, stress analysis in metals and composites, and in fracture mechanics. Prerequisite: C.E. 205. 3 units. *Dvorak*

**331. Special Problems of Systematic Analysis.** Roundoff and truncation errors. Bounds for approximate solutions. Higher order representations and their advantage and disadvantages. Connectivity matrices and systematic substructuring. Improved algorithms for linear equation solution and eigenvalue extraction. Prerequisite: C.E. 252 or consent of instructor. 3 units. *Utku*

**335. Mechanical Behavior of Soils.** Origin of soils, soil minerals, and processes of soil formation; physical chemistry of multiphase systems and soil structure. Permeability and flow of water through soils: capillary and osmotic phenomena; soil compressibility; theory of consolidation; shear strength and failure criteria. Stress-strain relationships, volume changes, and pore pressure during shear strength properties. Advanced laboratory soil testing techniques. 4 units. *Vesic*

**336. Advanced Soil Mechanics.** Theories of plastic and elastic equilibrium of soil masses and their application to analysis of problems such as pressure on retaining walls, anchored bulkheads, cofferdams, silos, shafts, and tunnels; stability of slopes; stresses and settlement in soil masses and pavement; piles and pile groups subjected to lateral loads. Prerequisite: C.E. 335. 4 units. *Vesic*

**337. Elements of Soil Dynamics.** Behavior of soils and foundations under transient and impact loads. Mechanics of pile driving. Foundation vibrations. Effects of explosions on soils: wave propagation, cratering. Earthquake effects on foundations, earth dams, and slopes. Compaction of loose soils by explosives or by vibration. Behavior of layered systems under dynamic loads. Prerequisite: C.E. 335 or consent of instructor. 3 units. *Vesic*

**350. Advanced Engineering Analysis.** Review of general mathematical properties of boundary value, eigenvalue, and initial value problems in continuum. Alternate equivalent formulations. Comparative survey of approximate methods for reducing continuum problems into equivalent discrete problems for numerical solutions. Prerequisites: Computer Science 221 and 222, or consent of instructor. (Also listed as Computer Science 350.) 3 units. *Utku*

**365. Advanced Topics in Civil Engineering.** Opportunity for study of advanced subjects relating to programs within the Civil Engineering Department tailored to fit the requirements of a small group. 1 to 3 units. *Graduate Staff*

**399. Special Readings in Civil Engineering.** Special individual readings in a specific area of study in civil engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff*

## ELECTRICAL ENGINEERING

Associate Professor H. Hacker, Jr., *Chairman* (130 Engineering); Professor Marinos, *Director of Graduate Studies* (173 Engineering); Professors Artley, Kerr, Nolte, Owen, Pilkington, Thurstone, Wang, and Wilson; Associate Professor Joines; Assistant Professor George

A student may specialize in any one of the following fields in working toward either the M.S. or the Ph.D. degree with a major in electrical engineering: solid state materials and devices; ferromagnetics; super-conducting circuits; instrumentation; electronics; microwaves; automatic control; energy conversion; digital systems; stochastic systems; and information processing.

Recommended prerequisites for the graduate courses in electrical engineering include a knowledge of basic mathematics and physics, electromagnetic theory, and network analysis. Students in doubt about their background for enrollment in specific courses should discuss the matter with the Director of Graduate Studies. The M.S. degree program includes either a thesis or an oral comprehensive examination. A qualifying examination is required for the Ph.D. degree program. These examinations are intended to test both the breadth and depth of the student's understanding of electrical engineering. There is no foreign language requirement.

**203. Random Signals and Noise.** Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. Fall semester. (Also listed as Computer Science 203.) One course. (3 graduate units.) *Kerr or Nolte*

**204. Information Theory and Communication Systems.** Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Spring semesters, 1976, 1978. Prerequisite: Electrical Engineering 203. One course. (3 graduate units.) *Marinos or Nolte*

**205. Signal Detection and Extraction Theory.** Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Spring semester. (Also listed as Computer Science 205.) Prerequisite: Electrical Engineering 203 or consent of instructor. One course. (3 graduate units.) *Nolte*

**206. Digital Signal Processing.** Introduction to the fundamentals of processing signals by digital techniques with applications to practical problems. Discrete time signals and systems, elements of the z-transform, discrete Fourier transform, digital filter design techniques, fast Fourier transform, and discrete random signals. Spring semester. One course. (3 graduate units.) *Nolte*

**208. Digital Computer Design.** Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also discussed. Prerequisite: Electrical Engineering 157 or consent of instructor. Spring semester. (Also listed as Computer Science 208.) One course. (3 graduate units.) *Marinos or Owen*

**211. Solid State Theory.** A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrodinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: consent of instructor. Fall semester. One course. (3 graduate units.) *Artley or Hacker*



**212. Solid State Materials.** Concepts of solid state physics as applied to engineering materials; electric magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; superconductors. Prerequisite: Electrical Engineering 211. Spring semester. One course. (3 graduate units.) *Artley or Hacker*

**213. Principles of Magnetism.** A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: consent of instructor. One course. (3 graduate units.) *Artley or Hacker*

**215. Semiconductor Physics.** A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: Electrical Engineering 211 or consent of instructor. One course. (3 graduate units.) *Hacker*

**217. Masers.** Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: consent of instructor. Some laboratory work. Spring semesters, 1977, 1979. One course. (3 graduate units.) *George*

**221. Nonlinear Networks and Systems.** Characterization of nonlinear multi-terminal network elements, formulation of system equations from topological and energy considerations. Basic properties and general methods of solution of resistive nonlinear networks. Time-varying linear systems. Examination of some fundamental properties of nonlinear differential equations. Spring semester. One course. (3 graduate units.) *Wilson*

**222. Nonlinear Analysis.** Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semester. (Also listed as Mechanical Engineering 232.) One course. (3 graduate units.) *Wilson*

**224. Integrated Electronics: Analog and Digital.** Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication techniques on circuitry design, a study of differential and operational amplifiers, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: Electrical Engineering 161 or equivalent. Fall semester. One course. (3 graduate units.) *Wilson*

**225. Semiconductor Electronic Circuits.** Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models; switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Spring semester. Prerequisite: consent of instructor. One course. (3 graduate units.) *Joines*

**227. Network Synthesis.** Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realiza-



bility condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Fall semesters, 1975, 1977. Prerequisite: consent of instructor. One course. (3 graduate units.) *George*

**241. Linear Systems.** Modeling of multiple input-output linear systems in the frequency and time domains. Matrix differential and difference equations and their solutions; state variables. Digital simulation of differential systems. Fourier analysis of signals and systems. Transform techniques applied to state variable models. State space models of distributed systems. Fall semester. One course. (3 graduate units.) *Kerr or Wang*

**242. Modern Control and Dynamic Systems.** See course description for Mechanical Engineering 230. (Also listed as Mechanical Engineering 230.) One course. (3 graduate units.) *Wright*

**243. Advanced Linear Systems Theory.** Linear spaces and linear operators. Impulse-response matrices. Controllability and observability. Irreducible realizations of rational transfer function matrices. Canonical forms, state estimators, and observer theory. Stability. Linear time-invariant composite systems. Prerequisite: Electrical Engineering 241. Spring semesters, 1976, 1978. One course. (3 graduate units.) *Kerr or Wang*

**251. Pattern Classification and Recognition.** Parameter estimation and supervised learning; nonparametric techniques; linear discriminant functions; clustering; language theory related to pattern recognition and syntactic pattern recognition; examples such as characters, severe weather recognition and classification of community health data, etc., are discussed. Prerequisite: consent of instructor. Spring semesters 1976, 1978. One course. (3 graduate units.) *Wang*

**265. Advanced Topics in Electrical Engineering.** Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and of instructor under whom work will be done. One course. (1 to 3 graduate units.) *Staff*

**266. Biofeedback Systems.** Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings will be considered in conjunction with experience in laboratory feedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experiential learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Undergraduate electrical engineering majors may not use this course as one of their four electrical engineering elective courses. Prerequisite: consent of instructor. Spring semester. One course. (3 graduate units.) *Artley*

**271. Electromagnetic Theory.** The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Fall semester. Prerequisite: consent of instructor. One course. (3 graduate units.) *Joines*

**272. Application of Electromagnetic Theory.** Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Spring semesters 1976, 1978. Prerequisite: Electrical Engineering 271. One course. (3 graduate units.) *Joines*

**297-298. Thesis Research.** 6 units.

**304. Estimation, Filtering, and Random Systems.** Statistical estimation and filtering techniques applied to signal analysis and system identification. Weiner and Kalman filter theory in the estimation of system state variables and system parameters. Statistical treatment of linear random operators and random differential equations. Applications to communications and control with selected computer exercises. Prerequisite: E.E. 203. Spring semester. 3 units. *Kerr*

**305. Advanced Applications of Statistical Decision Theory.** Optimum modulators and demodulators, comparison of various systems. Gaussian signals in Gaussian noise; sonar-radar problem, representation of narrow band processes, slowly fluctuating targets, optimum receiver for estimating range and Doppler, properties of autocorrelation functions and ambiguity functions, pseudo-random signals, resolution, frequency spreading, reverberation, active sonar, optimum space-time system, and passive sonar. Prerequisite: E.E. 205. Fall semesters 1976, 1978. 3 units. *Nolte*

**306. Adaptive Detection and Communication Systems.** Sequential detection, Wald's sequential probability ratio test, sequential tests of composite hypotheses, deferred decision theory; adaptive systems, nondecision-directed and decision-directed measurements, adaptive on-off communications systems, transmitted reference systems, detection systems employing the learning feature, learning with and without a teacher, pattern recognition. Applications to communication systems. Prerequisite: E.E. 205 (Also listed as Computer Science 306.) Fall semesters 1975, 1977. 3 units. *Nolte*

**307. Advanced Digital Systems I.** A unified treatment of discrete computational structures. Mathematical foundations of discrete parameter systems: semigroups, groups, rings, and fields. Sequential machines as sequence recognizers. Linear sequential structures. Elements of language theory. Prerequisite: E.E. 157 or consent of instructor. Fall semester. (Also listed as Computer Science 307.) 3 units. *Marinos*

**308. Advanced Digital Systems II.** A unified treatment of parallel computational structures. Petri nets, flow-graph schemata, parallel computational schemata (PCS), and other models of parallel computations. Actual realizations of parallel computational schemata are presented. Prerequisite: E.E. 157 or consent of instructor. Spring semester. (Also listed as Computer Science 308.) 3 units. *Marinos*

**\*313. Magnetic Processes in Materials.** Selected topics in magnetism. Cryomagnetism, spin wave resonance, interaction of superconductor and ferromagnetic materials, nonlinear spin wave theory, effects of finite dimensions and interfaces on basic properties of ferromagnets. Microwave applications. Prerequisite: E.E. 213 or consent of instructor. 3 units. *Hacker*

**321. Nonlinear Magnetic and Semiconductor Circuits.** Mathematical description of nonlinear magnetic and semiconductor characteristics; transient and steady-state analysis and synthesis of nonlinear systems with application of such topics as magnetic amplifiers, frequency converters, oscillators, computer logic, switching devices, and inverters. Prerequisite: consent of instructor. Spring semesters 1977, 1979. 3 units. *Wilson*

**324. Nonlinear Oscillations in Physical Systems.** Analysis of phenomena encountered in free and forced oscillating systems: stability criteria, topological methods, degenerate systems and discontinuous theories, relaxation oscillations, asymptotic approaches. Emphasis on interdependence of physical and

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\*Offered on demand.

mathematical reasoning in analyzing nonlinear electrical and mechanical systems. Illustrative examples selected to meet interests of class. Prerequisite: E.E. 222. Spring semesters 1976, 1978. 3 units. *Wilson*

**342. Optimal Control Theory.** Optimization problems for dynamic systems. Optimal feedback control. Linear systems with quadratic criteria; mathematical programming; optimal filtering and prediction; optimal feedback control in the presence of uncertainty. Prerequisite: E.E. 241. Spring semesters 1977, 1979. 3 units. *Wang*

**\*371. Advanced Electromagnetic Theory.** An advanced treatment of topics in electromagnetic theory selected from the interests of the instructor and students. Representative topics are propagation in anisotropic media, plasma waves, antennas, and boundary value problems. Prerequisite: E.E. 272. 3 units. *Joines or Hacker*

**\*373. Selected Topics in Field Theory.** An advanced treatment of topics in generalized field theory selected from the interests of the instructor and the students. Representative topics are generalized fields, electromagnetic interactions, quantum electrodynamics, inhomogeneous media, and diffusion phenomena. Prerequisite: E.E. 272. 3 units. *Artley or George*

**399. Special Readings in Electrical Engineering.** Special individual readings in a specified area of study in electrical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Staff*

## MECHANICAL ENGINEERING AND MATERIALS SCIENCE

Professor Chaddock, *Chairman* (142 Engineering); Assistant Professor Buzzard, *Director of Graduate Studies* (143 Engineering); Professors Clark, Garg, Harman, Linderoth, Macduff, and Pearsall; Adjunct Professor Roberts; Associate Professors Cocks, Elsevier, Shepard, and Wright; Adjunct Associate Professor Mayer; Assistant Professors Johnson and Shaughnessy

Graduate study is available to students seeking the M.S. and Ph.D. degrees with a major in either mechanical engineering or materials science. Departmental programs of advanced study and research include control systems, dynamics and vibrations, energy conversion, fluid mechanics, heat and mass transport, mechanical design, thermodynamics, physical metallurgy, corrosion, fracture, and polymer science. The faculty cooperates with faculty members from a number of other departments and schools to establish interdisciplinary research projects and programs of study in areas which include applied mechanics, biomechanics, biomedical materials, environmental quality and control, interaction of fields and materials, ocean engineering, systems engineering, engineering and public policy, and transportation systems.

The program includes the opportunity for experimental work as well as theoretical study. A major emphasis is placed upon developing the research ability of the student and relating the program to the evolving needs of modern engineering practice.

**202. Theoretical Thermodynamics.** Review of classical thermodynamics. Thermodynamics of continuum properties of real substances. Analysis of energy conversion with internal irreversibility and advanced engineering problems. Introduction to the statistical basis of thermodynamics. One course. (3 graduate units.) *Harman*

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\*Offered on demand.



**209. Structural Dynamics.** (Also listed as Civil Engineering 209.) One course. (3 graduate units.) *J. F. Wilson*

**210. Intermediate Dynamics.** Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible, continuous systems. ((Also listed as Civil Engineering 210.) One course. (3 graduate units.) *Macduff or J. F. Wilson*

**211. Theoretical and Applied Polymer Science.** An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention is paid to recent developments in the processing and use of modern plastics and fibers. Product design is considered in terms of polymer structures, processing techniques, and properties. One course. (3 graduate units.) *Clark or Pearsall*

**213. Advanced Materials Science.** An indepth study of current problems in materials applications conducted in a seminar format. Treatment will include thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Subjects intended to provide materials scientists and engineers with a theoretical basis for understanding and manipulating properties. Prerequisite: Engineering 83 and Mechanical Engineering 111 or 112. One course. (3 graduate units.) *Cocks, Pearsall, or Shepard*

**214. Corrosion and Corrosion Control.** Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. One course. (3 graduate units.) *Cocks or Shepard*

**215. Failure Analysis and Prevention.** A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or consent of instructor. One course. (3 graduate units.) *Cocks or Shepard*

**216. Materials Design and Resource Conservation.** The role of materials science and engineering in the field of resource conservation and recovery. Selection of materials for components of consumer products and equipment. Designing materials at atomic, molecular, and phase-structure levels to minimize energy consumption, optimize properties, and enhance recycling. Analysis of some constraints posed by thermodynamics, economics, raw material availability, and governmental policies. Prerequisite: Engineering 83. One course. (3 graduate units.) *Pearsall*

**221. Compressible Fluid Flow.** Basic concepts of flow of gases from the subsonic to the hypersonic regime. Effects of friction, heat transfer, and shock on one-dimensional inviscid flow. Potential theory, oblique shock waves, and special calculation techniques in two-dimensional flow. One course. (3 graduate units.) *Harman*

**222. Heat Transfer.** Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. One course. (3 graduate units.) *Chaddock or Buzzard*



**224. An Introduction to Turbulence.** Flow instability and the transition to turbulence. Physical characteristics of turbulent flows, averaging, and the Reynolds equation. Turbulent transport and mixing length theories. The statistical description of turbulence, correlations, and spectra. Fourier transforms. Measurement techniques. One course. (3 graduate units.) *Shaughnessy*

**226. Intermediate Fluid Mechanics.** A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. One course. (3 graduate units.) *Shaughnessy*

**230. Modern Control and Dynamic Systems.** The state-space point of view is used as a vehicle to integrate the classical control and modern systems techniques. Topics include vector differential equations, modal matrix transformations, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Also listed as Electrical Engineering 242.) One course. (3 graduate units.) *Garg or Wright*

**231. Systems Response and Control.** Methods, applicable to design, of obtaining parameters for strength, response, and stability studies to mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. One course. (3 graduate units.) *Macduff or Wright*

**232. Nonlinear Analysis.** Fall semesters. Prerequisite: consent of instructor. (Also listed as Electrical Engineering 222.) One course. (3 graduate units.) *T. Wilson*

**233. Fluid Control Systems.** A design oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; d.c. and a.c. hydraulic and pneumatic amplifiers. One course. (3 graduate units.) *Macduff*

**235. Advanced Mechanical Vibrations.** Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. One course. (3 graduate units.) *Macduff*

**236. Engineering Acoustics and Noise Control.** Specification of the physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personnel protectors. Prerequisites: Mechanical Engineering 123 and Mathematics 111. One course. (3 graduate units.) *Macduff*

**251. Refrigeration and Cryogenics.** Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Thermodynamics of vapor compression, air cycle, absorption, and thermoelectric refrigeration. Production of low and very low temperatures, helium

liquefiers. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. One course. (3 graduate units.) *Chaddock*

**255. Energy Conversion.** Principles, thermodynamics, and classification of energy conversion devices. Introduction to semiconductors, thermoelectric generators, photovoltaic generators, thermionic generators, magnetohydrodynamic generators, fuel cells, and other energy conversion devices. One course. (3 graduate units.) *Harman*

**265. Advanced Topics in Mechanical Engineering.** Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate or Graduate Studies and the instructor under whom work will be done. One course. (1 to 3 graduate units.) *Staff*

**270. Theory of Lubrication and Bearing Design.** A study and analysis of the theory of hydrodynamic and hydrostatic lubrication will be presented. The dynamics of bearing loading, bearing design, and materials will be examined in their relationships to the theory of lubrication. Properties of lubricants will be reviewed. The student will have ample opportunity to put theory into practice with real bearing problems taken from industrial machinery, construction equipment, transportation media, and wherever relative motion is required between adjacent surfaces. One course. (3 graduate units.) *Linderoth*

**280. Nuclear Reactor Power Cycles.** Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow, and materials problems unique to reactor design. One course. (3 graduate units.)

**300. Advanced Projects in Mechanical Engineering.** This course may be elected by students enrolled in a non-thesis program leading to the Master of Science degree. 3 units. *Graduate Staff*

**302. Advanced Thermodynamics.** Classical thermodynamics of inherently irreversible processes. Quantum and statistical thermodynamic analysis of properties of real substances and processes. Principles of general thermodynamics. 3 units. *Harman*

**311. Behavior of Crystalline Solids.** An advanced treatment of the dependence of structure on atomic bonding, and of properties on structure in crystalline solids. Crystal structures; phase diagrams and solid-state thermodynamics; physical properties; mechanical properties; kinetics of thermal treatments. 3 units. *Cocks, Pearsall, or Shepard*

**322. Mechanics of Viscous Fluids.** Equations of motion for a viscous fluid; general properties and selected solutions of the Navier-Stokes equations; laminar boundary layer equations with selected solutions and approximate techniques; origin of turbulence. 3 units. *Buzzard*

**323. Convective Heat Transfer.** Models and equations for fluid motion, the general energy equation, and transport properties. Exact, approximate, and boundary layer solutions for laminar flow heat transfer problems. Use of the principle of similarity and analogy in the solution of turbulent flow heat transfer. Two-phase flow, nucleation, boiling, and condensation heat and mass transfer. Prerequisite: Math. 285. 3 units. *Chaddock*

**324. Conduction and Radiation Heat Transfer.** Conduction heat transfer in steady and transient state. Radiation exchange involving absorbing and emitting

media including gases and flames, combined conduction and radiation and combined convection and radiation. Exact and approximate methods of solution including separation of variables, transform calculus, numerical procedures, and integral and variational methods. Prerequisites: Math. 285, M.E. 222 or equivalent. 3 units. *Buzzard or Chaddock*

**327. Homogeneous Turbulence.** Stochastic methods in turbulence theory. The kinematics of homogeneous turbulence. The dynamics of decay, universal equilibrium theory, and the probability distribution of velocity. 3 units. *Shaughnessy*

**328. Turbulent Shear Flow.** The Reynolds equation and the energy balance. Turbulent transport processes. Flow in channels and pipes. The turbulent boundary layer. Free turbulence: jets, wakes, and mixing layers. Recent theoretical and experimental work. 3 units. *Shaughnessy*

**331. Nonlinear Control Systems.** Analytical, computational, and graphical techniques for solution of nonlinear systems; Krylov and Bogoliubov asymptotic method; describing function techniques for analysis and design; Liapounov functions and Lure's methods for stability analysis; Aizerman and Kalman conjectures; Popov, circle, and other frequency-domain stability criteria for analysis and synthesis. Prerequisite: M.E. 230 or consent of instructor. 3 units. *Garg or Wright*

**333. Seminar in Control Systems.** Modern developments from the areas of system dynamics, linear, nonlinear, and optimal control; computational techniques for system analysis and synthesis; emphasis on recently published writing in the controls field; topics to be selected to match the interests of the student group; term paper required. Prerequisites: knowledge of basic linear control theory, computer programming, or consent of instructor. 3 units. *Garg*

**335. Analytical Methods in Vibrations.** Time and frequency domain analysis, generalized coordinates and Lagrange's equations, natural modes of continuous systems, approximate methods, damped systems, introduction to random vibrations. Prerequisite: M.E. 235 or consent of instructor. 3 units. *Wright*

**372. Finite Element Techniques in Design.** Finite element methods applied to design problems in stress analysis; temperature distribution; and flow problems. Derivation of state vectors and transfer matrices for rectangular and triangular elements; accuracy and computation methods; comparison with difference equation methods and available analytical results. 3 units. *Macduff*

**399. Special Readings in Mechanical Engineering.** Individual readings in advanced study and research areas of mechanical engineering. Prerequisite: approval of the Director of Graduate Studies. 1 to 3 units. *Graduate Faculty*

## English

Professor Budd, *Chairman* (323 Allen Building); Professor Nygard, *Director of Graduate Studies* (315 Allen Building); Professors Anderson, Cady, Duffey, Ferguson, Randall, Reiss, Ryals, Smith, Turner, and Williams; Associate Professors Butters, DeNeef, Gerber, Jackson, Jones, Mellown, Monsman, and Strandberg

The department offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees. A statement of the requirements for the A.M. and Ph.D. degrees may be obtained from the Director of Graduate Studies. The department requires a reading knowledge of one foreign language for the A.M. degree; for the Ph.D. degree, two languages determined by the student's committee.



## For Seniors and Graduates

**207. Old English Grammar and Readings.** One course (3 graduate units.)  
*Nygard or Reiss*

**208. History of the English Language.** Introductory survey of the changes in sounds, forms, and vocabulary of the English language from its beginning to the present, with emphasis on the evolution of the language as a medium of literary expression. One course. (3 graduate units.) *Nygard or Reiss*

**209. Present-Day English.** A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course. (3 graduate units.) *Butters, Nygard, or Reiss*

**210. Old English Literary Tradition.** Prerequisite: English 207. One course. (3 graduate units.) *Nygard or Reiss*

**212. Middle English Literary Tradition.** From 1100 to 1500 (excluding Chaucer); medieval genres; reading of selected texts. A reading knowledge of Middle English is recommended. One course. (3 graduate units.) *Nygard or Reiss*

**215. Chaucer.** *The Canterbury Tales*. One course. (3 graduate units.) *Nygard or Reiss*

**216. Chaucer.** *Troilus and Criseyde* and the minor poems. One course. (3 graduate units.) *Nygard or Reiss*

**221. English Prose of the Sixteenth Century.** Readings in the major forms and authors. One course. (3 graduate units.)

**222. English Non-Dramatic Poetry of the Sixteenth Century.** Extensive select readings from representative types and authors, excluding Spenser. One course. (3 graduate units.) *DeNeef*

**223. Spenser.** One course. (3 graduate units.) *DeNeef*

**224. Shakespeare.** The plays. One course. (3 graduate units.) *Williams*

**225, 226. Tudor and Stuart Drama, 1500-1642.** First semester: Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. Second semester: Jonson, Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. Two courses. (6 graduate units.) *Randall*

**229, 230. English Literature of the Seventeenth Century.** Major works in prose and poetry from 1600 to the death of Dryden. Two courses. (6 graduate units.) *DeNeef, Jackson, Randall, or Williams*

**232. Milton.** Milton's poetry and prose, with emphasis on the major poems. One course. (3 graduate units.)

**234. English Drama, 1642-1800.** The heroic play and comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. One course. (3 graduate units.) *Jackson*

**235, 236. The Eighteenth Century.** First semester: Swift, Pope, Defoe, Addison, Steele, and others. Second semester: Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. Two courses. (6 graduate units.) *Ferguson or Jackson*

**241, 242. English Literature of the Early Nineteenth Century.** First semester: poets and prose writers, 1790-1810, with emphasis on Wordsworth and Coleridge. Second semester: 1810-1830, with emphasis on Byron, Shelley, and Keats. Two courses. (6 graduate units.) *Monsman*



**245, 246. English Literature of the Later Nineteenth Century.** First semester: Carlyle, Dickens, Thackeray, Tennyson, and Browning. Second semester: Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. Two courses. (6 graduate units.) *Monsman or Ryals*

**251, 252. English Literature of the Twentieth Century.** Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. First semester: Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence. Second semester: Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. Two courses. (6 graduate units.) *Mellown or Smith*

**263, 264. American Literature, 1800-1865.** Emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. Two courses. (6 graduate units.) *Anderson, Jones, or Turner*

**267, 268. American Literature, 1865-1915.** Selected works of representative authors. First semester: Whitman, Mark Twain, James, Howells, Dickinson, and the Local Colorists. Second semester: Crane, Norris, Dreiser, Cather or Wharton, O'Neill, Robinson, and Frost. Two courses. (6 graduate units.) *Budd or Cady*

**270, 271. Southern Literature.** Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Twain, Glasgow, and Faulkner. Two courses. (6 graduate units.) *Turner*

**275, 276. American Literature since 1915.** First semester: selected fiction from Gertrude Stein to the present. Second semester: poetry from the Imagist movement to the present. Two courses. (6 graduate units.) *Duffey or Strandberg*

**280. Introduction to Folklore.** A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course. (3 graduate units.) *Nygard*

**285. Literary Criticism.** Readings from the major critics, Plato to the eighteenth century with emphasis on formative ideas and historical continuity. One course. (3 graduate units.) *Jackson*

**287. Recent Critical Thought.** Questions of the nature and value of literature as reflected in recent criticism, theoretical and practical. One course. (3 graduate units.) *Duffey*

**289. Literary Biography.** One course. (3 graduate units.)

## For Graduates

**310. Beowulf.** Reading and interpretation of the text. 3 units. *Nygard*

**312. Studies in Middle English Literature.** 3 units. *Nygard or Reiss*

**315. Studies in Chaucer.** 3 units. *Nygard or Reiss*

**318. Medieval Romances.** Origins, types, forms, themes; special attention to Arthurian materials. 3 units. *Reiss*

**320. Studies in Renaissance English Prose.** Close readings in various forms and authors as they reflect the culture and thought of the Renaissance. 3 units.

**324. Studies in Shakespeare.** Intensive study of carefully limited topics, together with critical analysis and interpretation of selected texts. 3 units. *Williams*

**325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries.** 3 units. *Randall*

**329. Studies in the Metaphysical Poets.** A careful study of Donne, Herbert, and Vaughan against the seventeenth century background, with some attention to their influence on other writers in the period and their impact on twentieth century poetry. 3 units. *Williams*

**330. Studies in Dryden and His Age.** The early poems, the important odes, the religious and political poems, selected critical and controversial prose, and the heroic play and tragedy. 3 units. *Jackson*

**337. Studies in Swift.** Intensive study of the major prose; selected readings in the verse, political writings, and miscellaneous prose. 3 units. *Ferguson*

**338. Samuel Johnson's Literary Criticism and Related Topics.** 3 units. *Ferguson*

**339. The Eighteenth Century Novel.** Richardson, Fielding, Smollett, and Sterne are emphasized. Attention is given to earlier prose fiction and to other contributing literary patterns. 3 units. *Ferguson or Jackson*

**341. Studies in English Romanticism.** 3 units.

**343. Studies in Coleridge and Carlyle.** 3 units.

**347. Studies in Victorian Poetry.** 3 units. *Monsman or Ryals*

**348. Studies in Victorian Fiction.** 3 units. *Ryals*

**349. Studies in Nineteenth Century Nonfictional Prose.** 3 units.

**353. Studies in British Poetry of the Twentieth Century.** Detailed examination of major poetic texts with background readings in prose. 3 units. *Smith*

**354. Studies in British Prose of the Twentieth Century.** Intensive study of the writings, both fiction and non-fiction of one major British author. *Mellown or Smith*

**361. Studies in a Major American Author of the Early Nineteenth Century.** 3 units. *Anderson, Jones, or Turner*

**362. Studies in a Major American Author of the Later Nineteenth Century.** 3 units. *Budd or Cady*

**364. Hawthorne and Melville.** Extensive reading in the works of Hawthorne and Melville, and close study of selected writings. 3 units. *Jones or Turner*

**368. Studies in American Realistic Fiction.** Intensive study of a post-Civil War novelist such as Howells, with lesser attention to a representative precursor such as De Forest, and a twentieth century writer such as Dreiser. 3 units. *Budd or Cady*

**369. Studies in American Humor.** The native tradition in the Down-East humorists and the humorists of the old southwest, in Mark Twain and his contemporaries, and afterward. 3 units. *Turner*

**376. Studies in Twentieth Century American Literature.** Selected problems posed by the poetry, prose, fiction, or drama of this century. 3 units. *Duffey*

**380. The Traditional Ballad and Folksong.** Studies in English, Scottish, and American popular poetry, with attention to the textual and musical traditions. No technical knowledge of music is required. 3 units. *Nygard*

**383. Textual Criticism.** The principles of analytical bibliography and their

application to problems and procedures in the study of Elizabethan printed books. 3 units. *Williams*

**387. Special Topics Seminar.** 3 units. *Staff*

## TUTORIALS

Specialized subjects of study will be offered, numbered in the 390's, to accommodate the interests of advanced graduate students. Tutorials will be offered to single students or to small groups. Instruction will be conducted in weekly sessions, or in more frequently scheduled sessions, if the instructor wishes. Emphasis will be on independent reading and investigation, and oral and written reports. A substantial amount of writing will be required.

Students are advised to consult the Director of Graduate Studies for a list of Tutorials currently scheduled for offering. 3 units. *Staff*

## Forestry and Environmental Studies

Professor Ralston, *Dean* (213 Biological Sciences Building); Professor Anderson, *Director of Graduate Studies* (04 Biological Sciences Building); Professors Barnes, Hellmers, Knoerr, Philpott, and Stambaugh; Associate Professor Yandle; Adjunct Associate Professors Clark, Heath, Hodges, Metz, and Vukovich; Assistant Professors Convery, Rajagopal, and Wuenscher

Major and minor work is offered in the natural and social aspects of forestry and related areas of natural resources leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees. Work for these degrees may be pursued in the biological science areas of dendrology, wood anatomy, forest ecology, tree physiology, biochemistry, forest entomology, and forest pathology; in the environmental science areas of forest soils, meteorology, and hydrology; in resource economics; and in forest mensuration, biometry, and operations research. College graduates who have had specialized training in professional forestry or the related basic areas of the natural or social sciences will be considered for admission. Students will be restricted to the particular fields of specialization for which their academic background qualifies them. For information on professional training in forestry, the *Bulletin of the School of Forestry and Environmental Studies* should be consulted.

The specific degrees available in forestry and related natural resources through the Graduate School are: the A.M. (with or without a thesis), M.S. (with a thesis), and the Ph.D. Students majoring in forestry may be required to demonstrate satisfactory knowledge of one or two foreign languages for the Ph.D. degree. More information on degree and language requirements can be found in the program information section of the *Bulletin*.

## BIOLOGICAL SCIENCE

### Dendrology and Wood Anatomy

**206F. Anatomy of Woody Plants.** (Also listed as Botany 206.) One course. (4 graduate units.) *Philpott*

**241F. Dendrology.** Nomenclature, classification, and identification of woody plants, with special reference to the tree species indigenous to southeastern United States and other important forest regions of temperate North America. Prerequisites: Biology 1-2 or equivalent. One course. (3 graduate units.) *White*

**292F. Microtechnique of Woody Tissue.** Preparation of wood for micro-

scopic study including sectioning, staining, and mounting techniques; elementary photomicrography. Prerequisites: Forestry 241 and 206 or equivalent. 3 units. *Philpott*

## Ecology

**243 E. S. Natural Resource Ecology.** An introduction to modern ecology as applied to natural resource management and environmental protection. Emphasis put on the ecosystem as the basic unit of management. Prerequisite: consent of instructor. One course. (3 graduate units.) *Wuenschel*

**277F. Seminar in Natural Resource Allocation and Efficiency.** Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for governmental policies in private property economics. Prerequisite: an advanced level course in nonmarket decision-making of Forestry 378 or its equivalent. 1 unit. *Convery*

**337. E. S. Ecological Analysis for Environmental Management.** Methods of analyzing ecosystems for environmental impact assessment, land use planning, and other environmental management applications. Lectures, laboratory, and field work in use of maps, aerial photographs, and field surveys for interpretation of physiographic and biological characteristics of terrestrial ecosystems. Prerequisites: Environmental Studies 243 and 341 and consent of instructor. 3 units. *Wuenschel*

**340 E. S. Ecology and Land Use Planning:** Consideration of the properties and processes of the natural environment as they relate to land use. Exploration of the biological, economic, legal, and social aspects of the application of ecological principles to the land use planning process. Prerequisites: Environmental Studies 341 and consent of instructor. 3 units. *Wuenschel*

**341 E. S. Ecological Principles in Environmental Management.** Discussion of the application of ecological principles to environmental manipulation. Methods of planning and managing human use of ecosystems while avoiding environmental deterioration. Stress put on the biological viewpoint. Prerequisites: general ecology and Environmental Studies 243 or other substantive course work in ecology. 3 units. *Wuenschel*

**346 E. S. Seminar in Environmental Policy.** Political, legal, and socioeconomic aspects of public and private action in environmental quality control and management. Prerequisites: Forestry 269 and Environmental Studies 341 or their equivalents and consent of instructor. 1 unit. *Convery or Wuenschel*

**347 E. S., 348 E. S. Natural Resource Ecology—Environmental Management Seminar.** Discussion of current ecological and environmental problems and research topics related to the management of natural resources. Credits to be arranged. *Knoerr and Wuenschel*

**349 E. S. Wildland and Wildlife Management.** The paradox of managed natural systems is considered in the context of plant, animal, and human population dynamics. Topics include vegetation management, wildlife management, and wilderness recreation management, including camping, backpacking, hunting, and fishing. Special attention is paid to wildland preserve and open space planning. 3 units. *Staff*

**354 E. S. Biological and Resource System Simulation.** Introduction to systems terminology. Differential and difference equations. Probabilistic concepts. Time and event simulations using problem oriented languages such as CSMP, SYNAMO, and GPSS. Applications in biological and resource sciences. Prerequisite: Forestry 250F and 253F or consent of the instructor. 3 units. *Rajagopal*



## Entomology

**222F. Biology of Forest Insects and Diseases.** Fundamentals of entomology and plant pathology as applied to forest protection; coordinated laboratory work with emphasis on identification and interpretation of forest and wood degradation. One course. (4 graduate units.) *Anderson and Stambaugh*

**225F. Chemical Aspects of Forest Protection.** Chemical aspects of organisms attacking trees and of materials used in their control. Emphasis on structures and properties in relation to functions and uses. Prerequisite: Forestry 222F. 3 units. *Barnes*

**230F. Forest Entomology.** Identification, biology, and control of insects that cause damage to trees and wood products. Emphasis of diagnosis is on the characteristics of the damage and the stages of the insects responsible. Prerequisite: Forestry 222 or equivalent or consent of instructor. 4 units. *Anderson*

**233F. General Entomology.** Principles of morphology, physiology, metamorphosis, and taxonomy of insects. Prerequisite: one course in entomology or zoology or consent of the instructor. One course. (4 graduate units.) *Anderson*

**331F. Toxicology of Insecticides.** Study of the physical, chemical, and biological properties of materials used to destroy insects. Formulation, toxicology, and insect physiology as related to insecticide action are emphasized. Prerequisite: one course in entomology; organic chemistry is recommended. 3 units. *Anderson*

**332F. Ecology of Forest Insects.** The influence of environmental factors on the vital processes of insects with emphasis on how both the abiotic and biotic elements influence the fluctuation of forest insect populations. Prerequisite: one course in entomology or zoology or consent of the instructor. 3 units or 4 units with laboratory. *Anderson*

**335F. Entomological Research Techniques.** Problem analyses, scientific writing, and laboratory and field research methods which are especially applicable to entomological problems. 1 unit. *Anderson*

**385F. Seminar in Forest Protection.** Discussion of current problems in entomology and pathology and evaluation of topical research for protection and control application in forest resource management. Prerequisites: Forestry 223 and 230. 1 unit. *Anderson and Stambaugh*

## Pathology

**222F. Biology of Forest Insects and Diseases.** (See description under Entomology.)

**223F. Forest Pathology.** Survey of major diseases of North American forests and their timbers, with emphasis on current literature. Field and laboratory study in diagnosis and infection biology. Prerequisite: Forestry 222 or equivalent, consent of instructor. 4 units. *Stambaugh*

**225F. Chemical Aspects of Forest Protection.** (See description under Entomology.) 3 units. *Barnes*

**321F. Phytopathological Technique in Forestry.** Fundamentals of phytopathology and their application to field and laboratory investigations of tree diseases and wood degradation; biological interpretation of host-pathogen-environment interaction is stressed in literature review, experimentation, and scientific writing. Prerequisite: Forestry 223 or equivalent. 4 units. *Stambaugh*

**322F. Microbiology of Forest Soils.** Qualitative and quantitative characteri-

zation of the microbial populations of forest soils with emphasis on rhizosphere interactions in root pathogenesis and mycorrhizal development; epidemiology of root diseases of trees; principles of control. Prerequisite: consent of instructor; mycology or bacteriology is recommended. 4 units. *Stambaugh*

**385F. Seminar in Forest Protection.** (See description under Entomology.)

### **Physiology and Biochemistry**

**205F. Tree Growth and Development.** Life processes, growth, and development of trees, with emphasis on physiological processes and environmental influences on structure, composition, and function. One course. (3 graduate units.) *Barnes*

**207F. Chemistry of Woody Tissues.** Composition of wood at the elemental, molecular, and macromolecular levels; both in woody plants and in processed woods. Distribution and properties of main components, and methods of analysis. Prerequisite: organic chemistry or consent of instructor. One course. (3 graduate units.) *Barnes*

**208F. Physiology of Wood Formation.** Processes involved in the growth and development of woody tissues, including internal control mechanisms and effects of environmental stresses on structure and composition. Prerequisites: Forestry 201 and 241 or equivalents. 3 units. *Barnes*

**225F. Chemical Aspects of Forest Protection.** (See description under Entomology.) 3 units. *Barnes*

**305F. Forest Biochemistry.** Biochemistry applied to structure and function of woody plants and associated fungi and insects. Prerequisites: courses in plant physiology and chemistry. 3 units. *Barnes*

## **ENVIRONMENTAL SCIENCE**

### **Soils**

**261F. Forest Soils.** Origin, development, and classification of soils with special emphasis on those developed in humid climates; morphological, physical, and chemical properties of soils in relation to growth of trees; effect of forests on soils. Prerequisites: Chemistry 1 and 2, and Physics 1, or equivalents; physical geology, mineralogy, petrology, and analytical chemistry are also desirable. 3 units. *Ralston*

**362F. Forest Soil Physics.** Analysis of the physical properties of soil related to the growth and development of forest trees. Consideration is given to the significance of soil moisture, temperature, aeration, and structural characteristics in the analysis of forest growth relationships. Prerequisite: Forestry 261. 3 units. *Ralston*

**364F. Soil Classification and Mapping.** Classification of soils as natural bodies. Mapping of soils, land use classes, and forest site classes; field study will be made of soils in either the coastal plain or mountains. Prerequisite: Forestry 261. 3 units. *Ralston*

**366F. Forest Soil Fertility.** The relationships of soil fertility factors in the growth of forest trees. Emphasis is placed on the analysis of soil factors related to the mineral nutrition of trees. Prerequisite: Forestry 262; analytical chemistry is recommended. 3 units. *Ralston*

### **Meteorology**

**203F. General Meteorology.** A general introduction to the science of mete-

orology, particularly for students concerned with problems in biology and hydrology. Emphasis is placed on the fundamentals and role of atmospheric thermodynamics and energy and mass transfer processes in determining both local and regional aspects of weather and climate. One course. (3 graduate units.) *Vukovich*

**204F. Microclimatology.** Introduction to the micrometeorological processes. Discussion of the integration of these processes and the resulting microclimates in the rural (forest, field, and water surface) and urban environments. Methods for modification of the microclimate. One course. (3 graduate units.) *Knoerr*

**215F. Air Pollution Meteorology.** The theory of transport and diffusion of air pollutants and its application to practical problems and computations involving both single sources and multiple sources, including urban communities; modeling of transport and diffusion, both in wind tunnels and computers; stack design from the meteorological point of view; the organization of meteorological networks and field studies; the measurement, monitoring, and equipment requirements of pertinent meteorological parameters; air pollution climatology; meteorological management of air pollution. Prerequisite: introductory course in general meteorology, Forestry 203 or equivalent. Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty from North Carolina State University. One course. (3 graduate units.) *Staff*

**217F. Environmental Instrumentation.** Theory and application of the physical basis for measuring parameters of natural and controlled environments. Properties and effective utilization of contemporary electronic measurement and data acquisition systems. Methods for obtaining and processing computer compatible experimental records. Three lectures and three laboratory hours per week. Prerequisite: consent of the instructor. Students should have a basic knowledge of the properties of environmental parameters and be able to write computer programs. 4 units. *Knoerr*

**\*304F. Atmospheric Turbulence and Diffusion.** Bulk and molecular aspects of atmospheric turbulence. Navier-Stokes equations and the Reynold's stresses. Mixing-length and statistical turbulence theories. Similarity hypotheses. Turbulent transfer and diffusion in adiabatic and diabatic atmospheres. Characteristics of turbulence in various scales of motion from the planetary to subinertial range. Prerequisites: Forestry 203 and differential equations or consent of instructor. 3 units. *Vukovich*

**\*306F. Dynamics of Local Atmospheric Motion.** Characteristics of atmospheric motion in the 100 m to 100 km scale. Analytic development from hydrodynamic and thermodynamic equations, incorporating appropriate scale forcing functions of heating and terrain roughness. Theory and characteristics of land and sea breezes, mountain and valley breezes, mountain waves and local modification of large scale atmospheric motion. Prerequisites: Forestry 203 and differential equations or consent of instructor. 3 units. *Vukovich*

**\*344F. Micrometeorology and Biometeorology Seminar.** Advanced topics in the physics of the earth's surface environment, with emphasis on plant and animal microclimates; budgets of mass, momentum, and energy; vertical structure of wind, temperature, water vapor, and carbon-dioxide in relation to exchange processes within the biosphere. Prerequisite: Forestry 204 or equivalent and consent of instructor. 2 units. *Knoerr*

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\*Offered on demand.

## Hydrology

**216F. Watershed Hydrology.** Influence of vegetation, soil types, and land forms on water yield, water quality, and flood potential. Analysis of precipitation patterns, infiltration rates, erosion forces, and sediment carrying capacities of streams. Techniques and research methods used to control the hydrologic cycle, water quality and water yield on wild lands. One course. (3 graduate units.) *Hellmers*

**\*342F. Hydrologic Processes.** Physical processes of the hydrologic cycle with emphasis on those processes which can be modified or controlled by watershed management. 3 units. *Knoerr*

## RESOURCE ECONOMICS AND POLICY

**269F. Resource Economics and Policy.** Development and critical review of concepts useful in understanding and evaluating the distribution of natural resource use over time in terms of the relations between technological knowledge, group and individual behavior, and social institutions. One course. (3 graduate units.) *Convery*

**270F. Economics of Forestry.** Development of the principles of economics useful in the analysis of the past, present, and prospective supply and demand situations for forestry goods and services: problems of the economics of the firm and industry, basic and peculiar to forestry, with special attention to the time dimensions of value; the role of forestry in the general economy including attention to relevant institutional factors. Prerequisite: Forestry 269 or one course in the principles of economics. 3 units. *Convery*

**273 E. S. Economics and Environmental Quality.** Consideration of the economic dimensions of the environmental problem. Exploration of the reasons for market failure; investigation of possible remedies, including a tax on residuals and direct control. Examination of the modifications required in cost-benefit and input-output analysis to incorporate environmental values. Discussion of economic growth, natural resource scarcity, and environmental quality. Prerequisite: consent of instructor. One course. (3 graduate units.) *Convery*

**277F. Seminar in Natural Resource Allocation and Efficiency.** Evaluation of economic principles concerned with problems of natural resource allocation, with special attention to the alternatives for government policies in private property economics. Prerequisite: an advanced level course in non-market decision-making or Forestry 378 or its equivalent. 1 unit. *Convery*

**378F. Seminar in Forest Economics.** Examination and discussion of the application of economic concepts in forestry, the potential contribution of economic analysis to private and public forest management; current research in forest economics. Prerequisites: Forestry 270 or consent of instructor; advanced courses in economics and economic theory are desirable. 2 units. *Convery*

## STATISTICS AND OPERATIONS RESEARCH

**250F. Biometry.** Concepts and methods of statistics essential to the collection, analysis, and interpretation of resource and biological data. Emphasis is placed on problems of estimation, inference, and decision-making with experimental data. One course. (3 graduate units.) *Yandle*

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\*Offered on demand.



**251F. Theory and Methods for Sampling Biological Populations.** Introductions to statistical methods for sampling natural resources and biological populations. Simultaneous consideration is given to theoretical and experimental problems in the design and applications of sampling methods and in the interpretation of sample data. Prerequisite: Forestry 250 or consent of instructor. One course. (3 graduate units.) *Yandle*

**253F. Computer Science in Natural Resources.** Organization of information storage and retrieval systems. Extensive use of Fortran (WATFIV) programming and statistical packages (SAS, TSAR) in resource and environmental decision-making. One course. (3 graduate units.) *Rajagopal*

**258F. Quantitative Analysis in Resource Management.** Mathematical model formulation and analysis in resource and environmental decision-making. Includes a survey of applications of linear programming, dynamic programming, CPM-PERT, inventory and statistical quality control in the resource sciences. Use of APL and MPS programming systems. 3 units. *Rajagopal*

**354 E.S. Biological and Resource System Simulation.** Introduction to systems terminology. Differential and difference equations. Probabilistic concepts. Time and event simulations using problem oriented languages such as CMSP, DYNAMO, and GPSS. Applications in biological and resource sciences. Prerequisite: Forestry 250 and 253 or consent of instructor. 3 units. *Rajagopal*

## SPECIAL STUDIES AND RESEARCH

**299F. Special Studies in Forestry.** Work on the senior-graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

**299 E. S. Independent Projects in Environmental Studies.** Work at the senior-graduate level to meet the needs of individual students in several areas of environmental studies. Credits and hours to be arranged. *Staff*

1. Environmental Planning. *Staff*
2. Environmental Economics. *Convery*
3. Applied Ecology. *Wuenschel*
4. Environmental Education. *Wuenschel*
5. Environmental Communication and Media. *Wuenschel*
6. Environmental Ethics and Values. *Wuenschel*
7. Environmental Design. *Staff*
8. Environmental Policy. *Convery*
9. Environmental Systems Analysis. *Rajagopal*

**301F, 302F. Advanced Studies in Forestry.** Work on the advanced graduate level to meet the needs of individual students offered in the areas of forestry and related natural resources designated under Forestry 357, 358. Credits and hours to be arranged. *Staff*

**301 E.S., 302 E.S. Advanced Projects in Environmental Studies.** Independent work at the advanced graduate level in areas designated under Environmental Studies 299. *Staff*

**357F, 358F. Research in Forestry.** Students with adequate training may undertake special research problems under direction of members of the faculty in the following branches of forestry and related natural resources. Credits to be arranged.

1. *Forest Ecology.* Prerequisite: Environmental Studies 243 or equivalent. *Wuenschel*
2. *Forest Soils.* Prerequisite: Forestry 261 or equivalent. *Ralston*

3. *Silviculture*. Prerequisites: Environmental Studies 243 and Forestry 244 or equivalents. *White*
4. *Forest Management*. Prerequisite: Forestry 281 or equivalent. *Chaiken*
5. *Forest Economics*. Prerequisite: Forestry 270 or equivalent. *Convery*
6. *Wood Anatomy and Properties*. Prerequisites: Forestry 241 and 206 or equivalents. *Philpott*
7. *Forest Mensuration and Biometry*. Prerequisites: Forestry 250 and 352 or equivalents. *Yandle*
8. *Forest Entomology*. Prerequisite: Forestry 230 or equivalent. *Anderson*
9. *Forest Operations Research*. Prerequisite: consent of instructor. *Rajagopal*
10. *Dendrology*. Prerequisite: Forestry 241 or equivalent. *White*
11. *Forest-Tree Physiology*. Prerequisites: plant physiology and plant or forest ecology. *Barnes or Hellmers*
12. *Forest Pathology*. Prerequisites: plant physiology and Forestry 223 or equivalents. *Stambaugh*
13. *Forest Meteorology and Hydrology*. Prerequisites: Forestry 203, 342, or equivalents. *Knoerr*
14. *Forest Biochemistry*. Prerequisites: plant physiology and organic chemistry. *Barnes*
15. *Regional Land Use Planning*. Prerequisites: Environmental Studies 337 and 340. *Staff*
16. *Environmental Studies*. Prerequisite: consent of instructor. *Staff*

**368F. Field Seminars.** Field studies, consultations, and visits to areas of interest during spring vacation period or at other times, in the several branches of forestry and related natural resources listed under Forestry 357, 358. Credits to be arranged. *Staff*

## RELATED COURSES IN OTHER DEPARTMENTS

Many courses available in other departments of the University are related to the biological, environmental, economics and policy, and biometrics and operations research areas of forestry and other natural resources. These courses offered in botany, zoology, biochemistry, chemistry, physics, engineering, mathematics, economics, business administration, sociology, and political science may be utilized by graduate students in the School of Forestry. For a specific listing of pertinent courses available in other departments see the *Bulletin of the School of Forestry and Environmental Studies*.

## The University Program in Genetics

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology and Immunology), Gillham (Zoology), and Guild (Biochemistry); Associate Professors Antonovics (Botany), Boynton (Botany), Counce (Anatomy), C. Ward (Zoology), F. Ward (Microbiology and Immunology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), and Kredich (Biochemistry)

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Graduate students registered in any of the biological sciences departments may apply to the faculty of the genetics program to pursue study and research leading to an advanced degree. It would be helpful if applicants for admission to the Graduate School indicated their interest in the genetics program at the time of application. Requests for information describing more completely the research interests of the staff, facilities, and special stipends and fellowships should be addressed to the Director, Genetics Program (Nanaline H. Duke Building, Room 151.)

### For Seniors and Graduates

**204. Introductory Genetics.** An introduction to genetic analysis with emphasis on the molecular basis of mutation, segregation, function, and organization of the genetic material. Primarily for medical students but graduate students may be admitted with the instructor's consent. (Also listed as Biochemistry 204.) Half course. (2 graduate units.) *Gross or Staff*

**216. Molecular Genetics.** An advanced course on genetic mechanisms and their relationship to nucleic acids and their synthesis. Prerequisites: intro-

ductory courses in biochemistry and genetics or consent of instructor. (Also listed as Biochemistry 216.) One course. (4 graduate units.) *Guild or Staff*

**280. Principles of Genetics.** An introduction to the structure and properties of genes and chromosomes and to the evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics. (Also listed as Botany 280 and Zoology 280.) One course. (3 graduate units.) *Antonovics, Boynton, or Gillham*

**282. Experimental Genetics.** A series of laboratory exercises and discussions on the molecular mechanisms of mutation, recombination, replication, transcription, and translation of the genetic material. May be taken concurrently with Genetics 280. Prerequisite: consent of instructor. (Also listed as Biochemistry 282.) Half course. (2 graduate units.) *Webster or Staff*

**284. Current Topics in Genetic Mechanisms.** A seminar and lecture course devoted to the analysis of the current literature in molecular genetics. Given in response to adequate demand. Prerequisites: Genetics 280 or its equivalent and consent of instructor. (Also listed as Biochemistry 284.) Half course. (1 graduate unit.) *Hall or Staff*

**285. Population Genetics.** A seminar and lecture course devoted to the analysis of the current literature in population genetics. Prerequisites: Genetics 280 or its equivalent and consent of the instructor. (Also listed as Botany 285.) One course. (3 graduate units.) *Antonovics or Staff*

**286. Evolutionary Mechanisms.** Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts and genetic divergence. Prerequisite: college biology. (Also listed as Botany 286 and Zoology 286.) 3 units. *Antonovics and H. Wilbur*

**287. Quantitative Genetics.** Methods of analyzing genetic variation in continuous traits. Models of continuous variation, genetic, environmental and interaction components; genetic correlation; heritability estimation; selection response. Prerequisite: genetics or Botany 280 or equivalent and consent of instructor. (Also listed as Botany 287.) One course. (3 graduate units.) *Antonovics*

**288. Seminar on the Role of the Cell in Development and Heredity.** Topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. (Also listed as Anatomy 288 and Zoology 288.) Half course. (2 graduate units.) *Counce*

## For Graduates

**336. Immunogenetics.** Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Test for histocompatibility including lymphocyte interaction and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed as Microbiology and Immunology 336.) 2 units. *Amos or Ward*

**351-352. Genetics Seminar.** Required of all students specializing in genetics. (Also listed as Biochemistry 351-352.) 1 unit per semester. *Gross or Staff*

## Geology

Professor Heron, *Chairman* (119 Science Building); Professor Perkins, *Director*



of Graduate Studies (111 Science Building); Professor Pilkey; Associate Professors Furbish and Lynts

The Department of Geology offers graduate work leading to the M.S. and Ph.D. degrees. An undergraduate degree in geology is not a prerequisite for graduate studies, but a student must have had or must take a summer field geology course (or equivalent experience), mineralogy, sedimentary rocks, stratigraphy, paleontology, and structural geology. In addition he must have had one year of college chemistry, one year of college physics, and mathematics through calculus.

Graduate courses in the Department of Geology are designed to provide specialized training in the fields of oceanography, sedimentology, stratigraphy, paleontology, and low-temperature mineralogy.

An acceptable thesis is required. There is no language requirement for the M.S. degree.

The Ph.D. degree is available through the Earth Science Consortium, a new inter-university doctoral program combining the faculties and research facilities of Duke, Emory, and Tulane Universities. The Earth Science Consortium offers specialization in the areas of paleontology, sedimentology, stratigraphy, marine geology, environmental geology, and regional geology. Under this program, a student admitted to Duke University would be expected to spend one year of study at another of the participating universities. Such a program offers the student a broadly-based faculty with diverse research interests and the opportunity to pursue graduate education in a variety of geologic settings. Normally, a candidate would hold the master's degree at the time of admission to the program. Additional information concerning the details of the doctoral program is available on request.

## For Seniors and Graduates

**205. Geological Oceanography.** The study of the broad geologic aspects of the ocean basins, including origin, bottom physiology, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. Not open to students who have completed Geology 206. Given at Beaufort. One and one half courses. (6 graduate units.) *Pilkey*

**206S. Principles of Geological Oceanography.** A survey of geological aspects of the oceans including sediment types, processes of sedimentation, geologic structures of the ocean basins, and bottom physiography. Prerequisite: Geology 108 or consent of instructor. One course. (3 graduate units.) *Pilkey*

**208. Shallow-Marine Geology.** Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. (3 graduate units.) *Perkins*

**211S. Stratigraphic Principles and Application.** Prerequisite: Geology 108. One course. (3 graduate units.) *Perkins*

**212. Facies Analysis.** Sedimentological models for the environmental interpretation of sedimentary sequences. Prerequisite: Geology 211. One course. (3 graduate units.) *Perkins*

**213. Sedimentology.** Parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. (3 graduate units.) *Pilkey*



**214S. Sediments in Thin Section.** Study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Prerequisite: Geology 213 or consent of instructor. One course. (3 graduate units.) *Perkins*

**222. Sedimentary Minerals.** Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. One course. (3 graduate units.) *Heron*

**229. Economic Geology.** Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geology 102. Given on demand. One course. (2 graduate units.) *Furbish*

**230. Principles of Structural Geology.** Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. One course. (3 graduate units.) *Staff*

**233. Geochemistry.** Application of the principles of chemistry to the solution of problems in geology. Prerequisites: Geology 102 and Chemistry 12. One course. (3 graduate units.) *Staff*

**241-242. Invertebrate Paleontology.** Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Lectures and laboratory. Prerequisites: Geology 1, 72, or consent of instructor. Given biennially. Two courses. (6 graduate units.) *Lynts*

**243-244. Micropaleontology.** Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution, and stratigraphic distribution. Lectures and laboratory. Prerequisites: Geology 241-242, or consent of instructor. Given biennially. Two courses. (6 graduate units.) *Lynts*

**247. Paleoecology.** Application of ecologic and geologic principles to the reconstruction of the interrelationships between organisms and their environment in geologic time. Prerequisites: Geology 213, 242, or consent of instructor. Given biennially. One course. (3 graduate units.) *Lynts*

## For Graduates

**\*300. Seminar in Oceanography.** 1 to 3 units. *Staff*

**305. Seminar in Continental Drift and Global Tectonics.** Given biennially. 3 units. *Lynts*

**\*310. Seminar in Stratigraphy.** 1 to 3 units. *Staff*

**\*312. Seminar in Sedimentology.** 1 to 3 units. *Staff*

**\*320. Seminar in Mineralogy.** 1 to 3 units. *Staff*

**\*330. Seminar in Geochemistry.** 1 to 3 units. *Staff*

**\*340. Seminar in Paleontology.** 1 to 3 units. *Staff*

**\*350. Seminar in Geomathematics.** 1 to 3 units. *Staff*

**\*371, 372. Advanced Topics in Geology.** To meet the individual needs of graduate students for independent study in various environmental sedimentary fields. 1 to 3 units. *Staff*

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\*Offered on demand.

# Germanic Languages and Literature

Professor Phelps, *Chairman and Director of Graduate Studies* (106 Foreign Languages); Associate Professors Borchardt and Rolleston; Assistant Professor Alt

The Department of Germanic Languages and Literature offers graduate work leading to the A.M. degree. Students who expect to major in German should have had sufficient undergraduate courses in Germanic languages to enable them to proceed to more advanced work.

Students who wish to take courses in German as a related field should normally have completed a third-year course (in exceptional cases, a second year) of college German with acceptable grades.

## For Seniors and Graduates

**201S, 202S. Goethe.** His life and works, in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose, fiction, and selected dramas; second semester: *Faust* I & II. Two courses. (6 graduate units.) *Phelps*

**203S, 204S. Eighteenth Century.** Eighteenth century German literature in its relation to European intellectual currents of that time. Two courses. (6 graduate units.) *Phelps*

**205, 206. Middle High German.** The language and literature of Germany's first classical period. Two courses. (6 graduate units.) *Borchardt*

**207S, 208S. German Romanticism.** The principal writers of the period from 1800 to 1850. Two courses. (6 graduate units.)

**209S, 210S. Kleist, Grillparzer, and Hebbel.** The development of the drama in Germany and Austria between Schiller and Naturalism. Two courses. (6 graduate units.) *Alt*

**211S, 212S. Nineteenth Century Literature.** From the end of Romanticism through Realism. Two courses. (6 graduate units.) *Alt*

**213S. Heinrich Heine.** The poet and his impact on his age. One course. (3 graduate units.)

**214S. The Twentieth Century.** Literature of the twentieth century presented through representative authors. One course. (3 graduate units.) *Rolleston*

**215S. Seventeenth Century Literature.** Leading writers of the Baroque, viewed against the background of their time. One course. (3 graduate units.) *Borchardt*

**216. History of the German Language.** Development of the phonology, morphology, and syntax of German from earliest beginnings to the present. One course. (3 graduate units.)

**217S. Renaissance and Reformation Literature.** The period from 1400 to about 1600. One course. (3 graduate units.) *Borchardt*

**218S. The Teaching of German.** A survey of modern teaching techniques; problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. One course. (3 graduate units.) *Phelps*

**219. Applied Linguistics.** The application of modern linguistic principles to a systematic study of the phonetics, morphology, and syntax of modern German. Prerequisite: consent of the instructor. One course. (3 graduate units.)

**232. Criticism.** Critical concepts, craft of interpretation, and readings from the great critics. One course. (3 graduate units.) *Alt or Borchardt*

**233. Advanced Composition.** Intensive study of syntax; practice in the writing of German prose, aiming toward the development of an expressive and fluent style. One course. (3 graduate units.)

### For Graduates

**\*301. Gothic.** 3 units.

**\*316. The Australian Novel from 1930 to the Present.** Studies in the novels of Herman Broch, Robert Musil, and Heimito von Doderer. 3 units.

**321, 322. Germanic Seminar.** 3 units per semester. *Alt, Borchardt, Phelps, or Rolleston*

— **Graduate Reading Course.** An intensive course in German to develop rapidly the ability to read German in several fields. Graduate students only. No credit.

### Related Courses in Other Departments

The following courses in other departments are recommended to students who are majoring in Germanics, as particularly valuable in building a proper background for Germanic studies.

a. Graduate courses in foreign or comparative literature or philology, offered by the ancient and modern language departments, to be selected after consultation with the Germanic Languages Department.

b. Graduate courses in history and philosophy, offered by those departments, to be selected after consultation with the Germanic Languages Department.

## Health Administration

Associate Professor Jaeger, *Chairman* (263 Baker House); Assistant Professor Smith, *Director of Graduate Studies* (237 Baker House); Professors Brown, Sessoms, and Warren; Adjunct Professor Kaluzny; Associate Professors McCool, Minniear, and Swanson; Adjunct Associate Professors Coulter, Kavalier, and Peck; Assistant Professors Blanks, Delaney, and Falcone; Lecturers Steinert and Winfree; Research Associate Warner

Graduate study leading toward preparation for a career in the administration of all types of health organizations and programs is offered through a twenty-month academic program that leads to the M.H.A. degree. Students without previous administrative experience in the health field are urged to undertake a twelve-month administrative residency following graduation. This residency is a period of varied administrative experience that is conducted under faculty supervision and is individually designed around each student's interests. For students without previous administrative experience, the residency should be considered an integral part of the M.H.A. program. Admission to this program is based upon suitability of the candidate to assume leadership roles in the organization and management of the delivery of health services, as well as on capability for graduate study.

**301. The Health System and Its Environment.** An introduction to the organi-

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\*Offered on demand.

zation and management of health services from a systems perspective. Emphasis is on the evolution of the present system and on the interplay of forces within the system and between the system and its environment. 4 units.

**312. Comparative Health Systems.** A comparative examination of the structure and performance of the health systems of the United States and other countries, particularly Canada and Great Britain. Topics include current financing, capitalization, utilization, control, and the relative role of the governmental and private sectors. 2 units.

**314. Social Dimensions of Health Services.** An epidemiological examination of health and disease in different population groups and their implications with regard to the structure and operation of health care delivery systems. 2 units.

**321. Operations Research for Health Administration.** Development of a quantitative modeling framework derived from the concepts of the systems approach to analyze management decisions in health administration. The focus of the course is on the knowledge and skills needed to manage the analysis (i.e., formulation, assumptions, interpretation, cost of analysis) rather than on performing the analysis, emphasizing the process of analysis over detail of techniques. Decisions are treated deterministically and stochastically, and on a scale from simple to complex. Techniques that serve the framework include calculus, inventory theory, PERT, decision analysis, fixed vs. variable cost analysis, queuing, simulation, and mathematical programming. The latter part of the course presents the concepts of quantitative control. 4 units.

**322. Public Policy and Health Care.** A study of the development and present status of selected public policy issues within their social, economic, and political contexts. Alternative courses of possible public action are reviewed and their probable outcomes are assessed. 2 units.

**324. Institutional Health Services.** A broad examination of the provision of health services in institutional settings. The principal focus is on the general hospital, but attention is also given to the mental hospital and other long-term care institutions. Specific study, utilizing lectures and cases, is made of the administrative and informational organization; the structure and function of each department; relationships between administration and the governing board, the medical staff, and the community; operational and capital financing; the planning function; and the evaluation of performance. 4 units.

**326. Health Economics.** The current state of knowledge with regard to the economics of health and medical care. Attention is given to the unique problems of demand and supply in the health services sector, as well as the implications of private and public financing alternatives; restrictions on manpower entry; incentive mobility; and problems of productivity measurement and change. 2 units.

**331, 332. Planning Health Services.** This course sequence addresses the planning for the delivery of health services, both at the systems level (area; community) and at the organizational level (institutions; program). Emphasis is on analytic techniques, measurement and evaluation, and the dynamics of the planning process. The courses include use of case studies and simulations. 4 units per semester.

**335. Ambulatory Health Services.** This course covers the noninstitutional components of the organization and provision of personal health services. The principal emphasis is on medical group management, including forms of organi-



zation, financing of services, physician-patient relationships, medical records, and peer review. Other topics include dental care, home care, halfway houses, multiphasic screening, and community health and mental health centers. 3 units.

**341, 342. Case Studies in Health Administration.** An integrating course sequence consisting of analysis of cases taken from institutional and programmatic health services settings. 3 units per semester.

**344. Health Manpower.** An analysis of the human resources component of the health services system, including professional and non-professional elements; resource development and distribution; occupational structure; assignment policies and staffing patterns; performance evaluation; and collective bargaining. 4 units.

**346. Community Health Services.** The focus of this course is the organization and management of health services directed toward general populations rather than individuals. Coverage includes aspects of environmental and occupational hygiene, nutrition and housing, planning community health services, preventive health education and programs, and other public health activities. Included are the problems associated with health status measurements and assessment. 3 units.

**348. Legal and Regulatory Constraints on Health Services.** This course treats the legal relationships between elements of the health system and the larger society of which it is a part. Attention is devoted to the certification, operation, and performance of health manpower, organizations, and services, and the difficulties in establishing effective restraints to minimize undesired results. The approach to the course includes the study of selected legislation, court cases, and research findings that assist in understanding formal constraints that affect the operation of the health systems. 2 units.

**350. The Administrative Residency (Basic).** The basic administrative residency is a period of training that is individually designed and provides a significant set of participatory experiences in various components of the health care systems. The two purposes of the residency are to broaden the student's knowledge of the actual operation of the systems and to further improve the student's ability to utilize in real settings the skills developed during the academic phase of training. Credit to be arranged.

**360. Seminar in Health Administration.** This seminar examines current issues confronting the delivery of health services. The focus is on managerial responses to these issues and the effect that these responses are likely to produce on the organization. 3 units.

**371, 372. Directed Research.** Credits to be arranged.

**380. Administrative Residency (Advanced).** This traineeship represents an optional experience available to the student with special professional objectives. Credit to be arranged.

## History

Professor Durden, *Chairman* (235 Allen); Professor A. Scott, *Director of Graduate Studies* (237 Allen); Professors Colton, Ferguson, Holley, Hollyday, Lerner, Oates, Parker, Preston, Ropp, W. Scott, TePaske, Watson, and Young; Associate Professors Cell, Chafe, Davis, Hartwig, Mauskopf, Miller, Nathans, Witt, and Wood; Assistant Professors Bergquist, Calkins, Dirlik, Gavins, Goodwyn, and Stone; Visiting Professor Brown

The Department of History offers graduate work leading to the A.M. and Ph.D. degrees. The candidate for the A.M. degree must have a reading knowledge of at least one ancient or modern foreign language related to his program of study and have completed successfully a substantial research paper, normally the product of a year's seminar or two semester-courses. The paper must be approved by two readers—the supervising professor and a second professor from the graduate staff. Students anticipating a May degree must have their papers read and approved by April 15; those anticipating a September degree must have their papers read and approved by August 15.

A candidate for the degree of Doctor of Philosophy is required to prepare himself for examination in four fields. Three usually shall be history. The choice of fields is determined in consultation with the student's supervisor and the Director of Graduate Studies. The department offers graduate instruction in the fields of Africa, Afro-American history, ancient history, medieval and early modern Europe, modern Europe, American history, Britain and the Commonwealth, Imperial Russia, modern Russia, Latin America, South Asia, modern China, modern Japan, military history, history of science, and history of medicine. The candidate for the Ph.D. degree usually must have a reading knowledge of two foreign languages, but in certain cases where the candidate's supervisor and the Director of Graduate Studies approve, and where the candidate's research for the dissertation would appreciably benefit, an alternative to the second language may be accepted. This alternative usually would take the form of successfully completed formal training in an auxiliary discipline (such as statistics or a course in one of the other social sciences with an emphasis upon methodology) of from 3 to 6 units, or their equivalent, depending on the student's program. It also must be in addition to any previous undergraduate work in the discipline. The requirement, whether satisfied by two languages or by one language and an alternative, must be met prior to the preliminary examination.

**Ancient History.** For courses in ancient history which may be taken for credit in either history or classical studies, see Classical Studies.

### For Seniors and Graduates

Students may receive credit for either semester of a hyphenated course at the 200-level without taking the other semester if they obtain written consent from the instructor.

**201S, 202S. Aspects of Change in Prerevolutionary Russia.** Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. Two courses. (3 graduate units per semester.) *Miller*

**203. The Uses of History in Public Policy Making: I.** (Also listed as Public Policy Sciences 271.) One course. (3 graduate units.) *Goodwyn*

**204. The Uses of History in Public Policy: II.** (Also listed as Public Policy Sciences 273.) One course. (3 graduate units.) *Kuniholm*

**207, 208. The Development of Urban America.** The process of urbanization from rural society to the modern city. Two courses. (3 graduate units per semester.) *Decker or A. Scott*

**209, 210. Selected Topics in Afro-American History, 1619-Present.** Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. (Also listed as Black Studies 209, 210.) Two courses. (3 graduate units per semester.) *Gavins*

**212. Recent Interpretations of United States History.** A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. (3 graduate units.) *Watson and Staff*

**215-216. The Diplomatic History of the United States.** (Not open to undergraduates who have had History 121-122.) Two courses. (6 graduate units.) *Davis*

**217, 218. Recent European History.** Two courses. (3 graduate units per semester.) *Brown*

**221. Problems in the Economic and Social History of Europe, 1200-1700.** One course. (3 graduate units.) *Witt*

**222. Problems in European Intellectual History, 1250-1550.** One course. (3 graduate units.) *Witt*

**223S, 224S. The Old Regime, the Enlightenment, and the French Revolution.** Political, social, and intellectual trends in seventeenth and eighteenth century Europe, with emphasis on France and the French Revolution. Two courses. (3 graduate units per semester.) *diCorcia*

**227-228. Recent United States History: Major Political and Social Movements.** Two courses. (6 graduate units.) *Chafe*

**229. Recent Interpretations of Modern European History.** A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern European history. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. (3 graduate units.) *Parker*

**231S, 232S. Problems in the History of Spain and the Spanish Empire.** Two courses. (3 graduate units per semester.) *TePaske*

**237S. Europe in the Early Middle Ages.** One course. (3 graduate units.) *Young*

**238S. Europe in the High Middle Ages.** One course. (3 graduate units.) *Young*

**240. Aspects of Traditional and Modern African Culture.** Introduction to the oral and written literatures and musical and artistic traditions. One course. (3 graduate units.) *Hartwig*

**241-242. Modernization and Revolution in China.** Two courses. (6 graduate units.) *Dirlik*

**247. History of Modern India and Pakistan, 1707-1857.** Analysis and interpretation, with special emphasis on social and economic change. One course. (3 graduate units.) *Calkins*

**248. History of Modern India and Pakistan, 1857 to the Present.** One course. (3 graduate units.) *Calkins*

**249-250. Social and Intellectual History of the United States.** The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. Two courses. (6 graduate units.) *Holley*

**253, 254. Modern European Intellectual History.** Two courses. (6 graduate units per semester.) *Parker*

**255S-256S. Problems in African History.** Two courses. (6 graduate units.) *Hartwig*

**257S, 258S. Modern East Asia: Introduction to Problems and Literature.** (Also listed as Interdisciplinary Course 257S, 258S and Political Science 257S, 258S.) Two courses. (3 graduate units per semester.) *Dirlik, McKean, and Stone*

**260. Economic History of Japan.** (Also listed as Economics 232.) One course. (3 graduate units.) *Bronfenbrenner*

**261-262. Problems in Soviet History.** Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. Two courses. (6 graduate units.) *Lerner*

**263-264. American Colonial History and the Revolution, 1607-1789.** The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. Two courses. (6 graduate units.) *Wood*

**265S, 266S. Problems in Modern Latin American History.** Two courses. (3 graduate units per semester.) *Bergquist*

**267S-268S. From Medieval to Early Modern England.** The intellectual, social, and political problems of transition to modern England, with special emphasis on the English Renaissance. Two courses. (6 graduate units.) *Ferguson*

**269-270. British History, Seventeenth Century to the Present.** Historiography of social structure and social change: English Revolution, party, the Industrial Revolution, class and class consciousness, Victorianism, and the impact of war in the twentieth century. Two courses. (6 graduate units.) *Cell*

**273, 274. Topics in the History of Science.** Critical stages in the evolution of scientific thought. Two courses. (3 graduate units per semester.) *Mauskopf*

**275S, 276S. Central Europe, 1848-1918.** Conflict between liberalism and authoritarianism, clash of nationalities, diplomatic interaction, emphasizing domestic changes in Germany and Austria-Hungary. Two courses. (3 graduate units per semester.) *Hollyday*

**277S. The Coming of the Civil War in the United States, 1820-1861.** One course. (3 graduate units.) *Durden*

**278S. The Civil War in the United States and its Aftermath, 1861-1900.** One course. (3 graduate units.) *Durden*

**279S. Oral History.** Techniques applied to social attitudes and problems in the United States. Prerequisite: consent of instructor. One course. (3 graduate units.) *Goodwyn*

**280. Historiography.** Great historians since Herodotus and an examination of recent twentieth century trends. One course. (3 graduate units.) *Parker*

**283-284. Political and Social Change in the United States, 1789-1800.** Two courses. (6 graduate units.) *Nathans*

**287-288. History of Modern Japan.** The political, economic, and social development of Japan since 1750; factors contributing to Japan's emergence as a modern state. Two courses. (6 graduate units.) *Stone*

**297S. The British Empire of the Nineteenth Century.** The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. One course. (3 graduate units.) *Preston*

**298S. The Commonwealth in the Twentieth Century.** The origins and evo-



lution of the Commonwealth of Nations and its adjustment in the age of anti-colonialism. One course. (3 graduate units.) *Preston*

### Seminars for Graduates

**307-308. Seminar in United States History.** 3 units per semester. *American History Staff*

**317-318. Seminar in the History of Western Europe.** 3 units per semester. *Hollyday and Scott*

**371-372.** Research seminars to be taken either in conjunction with colloquia listed below or by special arrangement with graduate instructors. When research seminars are not offered, independent research in a desired area may be worked out with the Director of Graduate Studies and the appropriate graduate instructor. Ad hoc colloquia may be worked out in years when a particular 351-352 colloquium is not formally offered; these colloquia do not appear on the official schedule of courses.

**401. Seminar on the British Commonwealth.** 3 units. *Preston or Others of the Committee on Commonwealth Studies*

### Colloquia for Graduates

Each colloquium described below deals with an aspect of history by means of readings, oral and written reports, and discussion, with attention to bibliography. In some instances, students may take the equivalent of a research seminar in conjunction with the colloquium and will be credited with an additional 6 units by registering for 371.1-372.1, etc.

**351.1-352.1. Military History.** 3 units per semester. *Ropp*

**351.2-352.2. Modern European Intellectual and Cultural History.** 3 units per semester. *Parker*

**351.10-352.10. Medieval Europe.** 3 units per semester. *Young*

**351.15-352.15. The English Renaissance.** 3 units per semester. *Ferguson*

**351.25-352.25. Central Europe, 1849-1914.** 3 units per semester. *Hollyday*

**351.30-352.30. European Diplomatic History Since 1870.** 3 units per semester. *W. Scott*

**351.31-352.31. Twentieth Century Europe.** 3 units per semester.

**351.40-352.40. City and Frontier in United States History.** 3 units per semester. *A. Scott*

**351.45-352.45. Reform and Politics in Nineteenth Century America.** 3 units per semester. *Durden*

**351.46-352.46. Twentieth Century United States to 1941.** 3 units per semester. *Watson*

**351.47-352.47. Diplomatic History of the United States.** 3 units per semester. *Davis*

**351.51-352.51. Hispanic America.** 3 units per semester. *TePaske*

**351.60-352.60. Soviet History.** 3 units per semester. *Lerner*

**351.65-352.65. Modernization and Revolution in China.** 3 units per semester. *Dirlik*

**351.70-352.70. Modern South Asia.** 3 units per semester. *Calkins*

**351.74-352.74. American Colonial History and the Revolution.** 3 units per semester. *Wood*

### **Historiography and the Teaching of History—For Graduates**

**312. Seminar in the Teaching of History in College.** The work in this course is intended to acquaint students with the problems involved in teaching history in college. Required of all candidates for the degree of Doctor of Philosophy who are in residence for two years at Duke. As an alternate method of meeting this requirement, a graduate student may, in cooperation with a member of the faculty, serve a one-semester teaching apprenticeship. Year course. No credit. Supervised by Director of Graduate Studies.

**314. Historical and Social Science Methodology.** Methods used in historical research with emphasis upon the various social science approaches. 3 units. *Chafe*

History 314 or History 280 is required of all candidates for the Ph.D. degree who are in residence for two years at Duke University.

### **Independent Study**

**399.** Supervised independent study and reading, with consent of professor. 3 units.

## **Marine Sciences—The University Program**

Professor Costlow, *Director*; Professor Bookhout (Zoology), Johnson (Botany), and Pilkey\* (Geology); Associate Professors Barber (Zoology and Botany) and Searles\* (Botany); Assistant Professors Baier (Chemistry), Blankley (Botany), Forward (Zoology), Gutknecht (Physiology), Sullivan (Biochemistry), and Sutherland (Zoology)

Training in the marine sciences at Duke University includes marine biology, marine geology, and oceanography. The departments which are chiefly concerned are botany, chemistry, geology, and zoology.

A graduate student working in the marine sciences will take his degree under the auspices of one of the above departments and must, therefore, meet the requirements of that department. During the first part of his training he will usually take courses on the Durham campus during the academic year and enroll in more specialized courses in the marine sciences at the Duke University Marine Laboratory during the summer. After the completion of his course work and preliminary examination (for doctoral candidates) he may, with approval of his major professor, request space for thesis research at the Marine Laboratory.

Persons interested in graduate work in marine sciences should apply through one of the appropriate departments. Forms may be obtained from the Graduate School.

Applications for summer courses at the Laboratory should be addressed to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516. The form may be obtained from the Duke University *Marine Laboratory Bulletin*. The application for enrollment in the Duke University summer session should be accompanied by transcripts of undergraduate and graduate work. Applications should be received before March 10.

Students registering for research should do so under the appropriate departmental numbers.

The following courses are offered during the summer at Beaufort. See the Duke University *Marine Laboratory Bulletin* for the current schedule of courses.

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\*In residence at the Marine Laboratory during the summer only.

**202. Phytoplankton Systematics.** Taxonomy and classification of marine phytoplankton: their general characteristics, phytogeography, life histories, and techniques for preservation, preparation, and enumeration of phytoplankton samples. Individual projects. Given at Beaufort. (Listed as Botany 202.) One and one half courses. (6 graduate units.) *Forward*

**203. Marine Ecology.** The application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current literature. Prerequisites: a course in general zoology or invertebrate zoology and calculus. Knowledge of statistics helpful. (Also listed as Zoology 203L.) One and one half courses. (6 graduate units.) *Staff*

**204. Marine Microbiology.** The major groups of marine microorganisms: bacteria, fungi, protozoa, and phytoplankton—their taxonomy, culture, physiology, and ecology. Field and laboratory work with observational and experimental methods on the dynamics of marine microorganisms. Prerequisite: a course in general biological science or botany. Given at Beaufort. (Listed as Botany 204.) One and one half courses. (6 graduate units.) *Johnson*

**205. Geological Oceanography.** The study of the broad geologic aspects of the ocean basins, including origin, bottom physiography, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. This course is not open to students who have completed Geology 206. Given at Beaufort only. (Also listed as Geology 205.) One and one half courses. (6 graduate units.) *Pilkey*

**211. Marine Phycology.** An introduction to marine algae: their identification, taxonomy, morphology, physiology, and ecology. Field trips are complemented by laboratory study, culturing, and preparation of herbarium material. (Listed as Botany 211.) One and one half courses. (6 graduate units.) *Searles*

**212. Membrane Physiology and Osmoregulations.** Physiology of marine and estuarine organisms, with emphasis on cellular transport processes and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, electrophysiology and synaptic transmission in mollusks, renal and gill transport processes in fish, amino acid transport and metabolism in crustaceans, and the application of radiotracer function. Prerequisite: consent of instructor. (Listed as Physiology 212.) One and one half courses. (6 graduate units.) (Not given summer 1976.) *Gutknecht*

**214. Biological Oceanography.** Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment provide the core of the biological oceanography course. Ideas emphasized are: cycling of energy and matter through marine ecosystems; role of physical and chemical processes in regulating the abundance; distribution; community organization of marine organisms. A cruise on the R/V *Eastward* will investigate the physical and chemical processes which support the biological productivity of the continental shelf ecosystem. Prerequisite: consent of instructor. (Listed as Zoology 214.) One and one half courses. (6 graduate units.) *Barber*

**230. Environmental Oceanography.** Examination of chemical, biological



and geological aspects of pollution in the marine environment. The interaction of man's action with natural marine processes on shore lines and shelves. Application of marine science to compatible utilization of marine resources. Prerequisites: consent of instructor. A knowledge of physical chemistry is desirable. (Also listed as Chemistry 230.) One and one half courses. (6 graduate units.) *Baier and Staff*

**240. Chemical Oceanography.** Distribution, alternation, and transport of chemical species in the marine environment. R/V *Eastward* cruise to gather samples for evaluating chemical processes in the ocean. Prerequisites: consent of instructor. A knowledge of physical chemistry is desirable. Given at Beaufort. Includes lectures, laboratory work, and field trips. (Also listed as Chemistry 240.) One and one half courses. (6 graduate units.) *Baier*

**250. Physiological Ecology of Marine Animals.** The physiology of marine and estuarine animals in relation to certain environmental factors (temperature, salinity, oxygen, and light). Prerequisite: a course in physiology and general zoology. (Listed as Zoology 250). One and one half courses. (6 graduate units.) *Forward*

**252. Marine Electrobiology.** The physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysiological studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. Ionic basis of bioelectric signals within and between cells, relation of bioelectric signals to particular behavioral patterns, effects of externally applied electric fields, bioelectric communication and navigation systems. Prerequisites: consent of instructor. Summer at Beaufort. (Also listed as Biomedical Engineering 252.) One and one half courses. (6 graduate units.) *Wachtel and Wolbarsht*

**274. Marine Invertebrate Zoology.** Study of invertebrate animals in the Beaufort region. Field trips will be made to a variety of habitats to study and collect animals in their natural environment. The structure and habits of living invertebrates and their behavior under experimental conditions will be studied in the laboratory. (Zoology 274 is not intended for students who have had a graduate course in invertebrate zoology). Prerequisite: a course in general zoology or general biology. (Listed as Zoology 274.) One and one half courses. (6 graduate units.) *Barnes*

**276. Comparative and Evolutionary Biochemistry.** Lectures and discussion of the origin of life, evolution of the genetic code, mutation and protein polymorphism, natural selection and protein structure, and comparison of homologous proteins and nucleic acids. Laboratory work involves the purification and characterization of homologous proteins from fish and invertebrates. Techniques used include salt fractionation electrophoresis, ion-exchange and molecular exclusion chromatography, fingerprinting, molecular weight determination, amino acid composition, and other related approaches. Prerequisite: consent of the instructor. Given at Beaufort. (Listed as Biochemistry 276.) One and one half courses. (6 graduate units.) *Sullivan*

**278. Invertebrate Embryology.** Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisite: consent of the instructor. Given at Beaufort. (Also listed as Zoology 278. One and one half courses. (6 graduate units.) *Bookhout*

**353, 354. Research.** Hours to be arranged. Prior approval of instructor at



the Duke University Marine Laboratory is required. (For graduate students only.) *Staff*

## Mathematics

Professor Warner, *Chairman* (135C Physics Building); Professor Weisfeld, *Director of Graduate Studies* (230 Physics Building); Professors Allard, Carlitz, Murray, Reed, and Shoenfield; Associate Professors Burdick, Hodel, Kitchen, Kraines, Moore, Scoville, Smith, and Stackelberg; Visiting Associate Professor Gut; Adjunct Associate Professor Chandra; Assistant Professors Cantor, Lees, and MacKichan

Graduate work in the Department of Mathematics is offered leading to the M.S., A.M., and Ph.D. degrees. The student, in his undergraduate work, must have had courses in differential and integral calculus, and at least 6 semester hours of other courses in mathematics on the junior or senior level.

The department offers a program in applied statistics with a minor in computer science leading to the M.S. degree. The program consists of 24 units of graded course work plus a thesis involving the use of the computer.

All A.M. and Ph.D. degree candidates are required to pass a comprehensive examination in the areas of algebra, analysis, and topology. Students will usually take the comprehensive examination after completing their first year of graduate study and just prior to the start of their second year.

The A.M. degree with a major in mathematics is awarded primarily on the basis of scholarship. It requires 30 units of graded work in addition to the comprehensive examination. A thesis may be substituted for 6 units of course work only in unusual circumstances.

The Ph.D. degree in mathematics is awarded upon the demonstration of ability and training in research. The original dissertation, therefore, is the most important of the formal requirements for the degree.

All A.M. and Ph.D. degree candidates are expected to participate in a pro-seminar during their first year of graduate study. The purpose is to provide experience in organizing and presenting material to their peers.

Since a reading knowledge of French, German, and Russian is highly desirable for a student of mathematics, the Ph.D. degree candidate should satisfy the language requirement in two of these languages as early as possible. The department offers departmentally administered language examinations as an alternative to the ETS examinations.

### For Seniors and Graduates

**204. Geometry for Teachers.** Metric and synthetic approaches to plane and solid geometry; affine geometry, and an algebraic model of Euclidean geometry. One course. (3 graduate units.) *Staff*

**206. Introduction to Stochastic Processes.** Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. One course. (3 graduate units.) *Staff*

**207, 208. Introduction to Algebraic Structures.** Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prereq-

uisites: Mathematics 103 and 104 for 207; and 207 for 208. Two courses. (6 graduate units.) *Warner*

**217, 218. Intermediate Analysis.** Elementary point set topology and differential calculus in  $n$ -space; implicit and inverse function theorems; integration theory; differentiable manifolds; differential forms; generalized Stokes' theorem. Prerequisite: Mathematics 103 and 104 for 217; and 217 for 218. Two courses. (6 graduate units.)

**221, 222, 223. Numerical Analysis.** For a description of these courses, see Computer Science 221, 222, 223. Three courses. (9 graduate units.) *Patrick*

**\*227, 228. Theory of Numbers.** Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisites: Mathematics 103 and 104 for 227; and 227 for 228 or equivalent. Two courses. (6 graduate units.) *Staff*

**\*229, 230. Algebraic Numbers.** Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisites: Mathematics 207 for 229; and 229 for 230. Two courses. (6 graduate units.) *Carlitz*

**231. Applications of Graph Theory.** Linear graphs, matrix representations, cycle structure, isomorphism, connectivity, independence, planarity, coloring, directed graphs, flows in networks as applied to engineering, management, computer science, urban systems, chemistry, physics, economics, sociology, psychology. Prerequisite: Mathematics 103 and 104 or equivalent. One course. (3 graduate units.) *Staff*

**\*234. Sample Designs.** Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multistage sampling; methods of estimation; questionnaire construction; refusal and non-response. Prerequisite: Mathematics 183. One course. (3 graduate units.) *Staff*

**235, 236. Algebra.** Elementary categorical algebra; groups with operators,  $G$ -sets structure groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. Two courses. (6 graduate units.) *Staff*

**244. Analysis of Variance.** Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. One course. (3 graduate units.) *Staff*

**\*245, 246. Combinatorial Analysis.** Generating functions, permutations, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. Two courses. (6 graduate units.) *Carlitz*

**\*247, 248. Arithmetic of Polynomials.** Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisites: Mathematics 207 or consent of instructor for 247; and 247 for 248. Two courses. (6 graduate units.) *Carlitz*

**256. Orientation for Applied Mathematics.** Simulation and related notions; relation of science and technology with evolution of mathematics; modern generalizations of the concepts of language, validity, empirical science, and statistical inference. Areas of application for various specific mathematical topics. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Murray*

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\*Offered on demand.

**260. Design of Experiments.** Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. One course. (3 graduate units.) *Burdick*

**\*262. Non-Parametric Statistics.** A study of statistical tests in which no assumption about the underlying distribution is made; single and multiple sample tests for nominal and ordinal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 136 or consent of instructor. One course. (3 graduate units.) *Staff*

**265, 266. Homological Algebra and its Applications.** Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. Two courses. (6 graduate units.) *Weisfeld*

**268. Mathematical Foundations of General Relativity.** Review of special relativity, the structure of Lorentz manifolds, curvature tensors and geodesics, the momentum-energy tensor and the Einstein field equations, the Schwarzschild solution and gravitational collapse. Prerequisite: Mathematics 104 or 111, and Physics 42, or consent of instructor. (Also listed as Physics 268.) One course. (3 graduate units.) *Cantor*

**269, 270. Recursive Function Theory.** Basic properties, enumeration theorems, hierarchies, recursive functions of higher types, generalized recursion theory; applications. Prerequisite: Mathematics 187 or consent of instructor. Two courses. (6 graduate units.) *Shoenfield*

**271. Point Set Topology.** Basic topological properties, including compactness, connectedness, separation axioms, and countability properties; metric spaces; product and function spaces. Prerequisite: Mathematics 139 or equivalent. One course. (3 graduate units.) *Staff*

**272. Introductory Algebraic Topology.** Fundamental group and covering spaces; homology groups of cell complexes; classification of compact surfaces; the cohomology ring and Poincaré duality for manifolds. Prerequisite: Mathematics 271. One course. (3 graduate units.) *Staff*

**273. Algebraic Topology.** Fibrations, confibrations and Puppe sequences; homology, cohomology and homotopy theories; Hurewicz isomorphisms theorem; Brown representation theorem; generalized cohomology theories. Prerequisite: Mathematics 272. One course. (3 graduate units.) *Staff*

**274. Geometric Topology.** Handle decomposition of manifolds, isotopy extension theorem; geometric and algebraic intersection numbers; Whitehead torsion and the s cobordism theorem. Prerequisite: Mathematics 272. One course. (3 graduate units.) *Staff*

**275, 276. Probability.** Foundations of probability; random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 291 or consent of instructor. Two courses. (6 graduate units.) *Staff*

**284. Least Squares Analysis of Linear Models.** General linear models; geometrical interpretations; multiple regression; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models;

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\*Offered on demand.



analysis of covariance; introduction to nonlinear models. Prerequisite: Mathematics 136. One course. (3 graduate units.) *Burdick*

**285. Applied Mathematical Methods I.** Heat equation, wave equation, separation of variables, Fourier series, introduction to Hilbert space, Fourier transform, potential theory; complex variables, residues. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Reed*

**286. Applied Mathematical Methods II.** Eigenvalue problems, integral equations, Fredholm alternative, bounded linear transformations on Hilbert space, applications to partial differential equations, techniques for approximating eigenvalues. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Reed*

**\*287, 288. Foundations of Mathematics.** Propositional calculus, predicate calculus, axiomatized number theory. Gödel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103, or consent of instructor. (Also listed as Philosophy 287, 288.) Two courses. (6 graduate units.) *Shoenfield*

**290. Stochastic Processes.** Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. One course. (3 graduate units.) *Staff*

**291, 292. Analysis I, II.** Measure and integration theory; introduction to functional analysis; theory of analytic functions. Prerequisite: Mathematics 218 or 140, or consent of instructor. Two courses. (6 graduate units.) *Staff*

**293. Multivariate Statistics.** Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's  $T^2$  statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284 or consent of instructor. One course. (3 graduate units.)

**\*295. Mathematical Foundations of Statistical Inference.** Inference-theoretic approach to hypothesis testing, decision making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful tests; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. One course. (3 graduate units.) *Staff*

**297, 298. Axiomatic Set Theory.** Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Shoenfield*

## For Graduates

**\*303, 304. Advanced Theory of Numbers.** Cubic and quartic reciprocity, partitions and diophantine analysis, sums of squares. Prerequisite: Mathematics 288 or consent of instructor. 3 units per semester. *Carlitz*

**325, 326. Analysis III, IV.** Advanced topics in complex and real analysis, measure and integration theory, functional analysis. Prerequisite: Mathematics 292 for 325; and 325 for 326. 3 units per semester. *Murray*

**\*327, 328. Partial Differential Equations.** Boundary and initial value prob-

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\*Offered on demand.



lems, regularity and existence theorems by methods of *a priori* estimates and functional analysis. Representations of solutions, spectral theory, and potential theory. Prerequisite: Mathematics 291-292 or consent of the instructor. 3 units per semester. *Staff*

**\*329, 330. Theory of Distributions.** Test functions, distributions, topological vector spaces, applications to the operational calculus, partial differential equations, and mathematical physics. 3 units per semester. *Staff*

**\*331, 332. Advanced Topics in Complex Variables.** Entire and meromorphic functions; harmonic functions and potential theory; Riemann surfaces; several complex variables. 3 units per semester. *Staff*

**\*333, 334. Analytic Theory of Numbers.** Distributions of primes, primes in an arithmetic progression. Waring and Goldbach problems, applications of elliptic functions. Prerequisite: Mathematics 291-292. 3 units per semester. *Carlitz*

**\*335, 336. Topics in Algebra.** Advanced topics in algebra to be selected from areas of current research. Prerequisite: Mathematics 236 or consent of the instructor. 3 units per semester. *Staff*

**\*343, 344. Differential Equations.** Manifolds, sheaves, differential operators and their prolongations, Spencer sequences,  $\delta$ -cohomology, existence theorems for analytic partial differential equations, the  $\delta$ -estimate, D-Neumann problem. Prerequisites: Mathematics 236, 272, and 292, or consent of the instructor. 3 units per semester. *Staff*

**\*353, 354. Topics in Analysis.** Advanced topics in real and complex analysis to be selected from areas of current research. Prerequisite: Mathematics 325, which may be taken concurrently. 3 units per semester. *Staff*

**361, 362. Hilbert Space.** Spectral theory for Hermitian and unitary transformations; maximal symmetric transformations; canonical resolution of closed transformations; singular integral equations; the Weyl circle; indices for differential operators; deficiency characteristics of closed transformations; topologies for bounded transformations; von Neumann algebras; resolution theory; Abelian and factor rings. Prerequisites: Mathematics 236 and 292, or consent of instructor. 3 units per semester. *Murray*

**\*371, 372. Dimension Theory.** Theory of covers in normal spaces; inductive and covering dimension of metric spaces and of normal spaces; dimension of Euclidean spaces, mapping in spheres and applications; metric dimension and other metric-dependent functions. Prerequisites: Mathematics 271-272. 3 units per semester. *Hodel*

**375. Advanced Point Set Topology.** Advanced topics in point set topology to be selected from areas of current research. 3 units per semester. *Hodel*

**\*377, 378. Topics in Topology.** Advanced topics in topology to be selected from areas of current research. 3 units per semester. *Staff*

**\*383, 384. Lie Groups and Algebras.** Differential manifolds; Lie groups; one-parameter subgroups; Lie algebras; differential forms; classification and representations of compact Lie groups and semisimple Lie algebras; solvable and nilpotent algebras; Ado's theorem. Prerequisites: Mathematics 236, 271 and either Mathematics 218 or 291. 3 units per semester. *Shoenfield*

**\*392. Nuclear Spaces.** The theory of nuclear locally convex spaces, as de-

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\*Offered on demand.

veloped by Grothendieck and Pietsch; applications to spaces of distributions. Prerequisite: Mathematics 292. 3 units. *Moore*

**\*393. Topological Groups.** Elementary theory; Haar measure; compact groups; locally compact Abelian groups; duality theory. Prerequisites: Mathematics 236 and 272, or consent of instructor. 3 units. *Warner*

**\*394. Topological Rings.** Compact, locally compact, and linearly compact rings. Prerequisite: Mathematics 393 or consent of instructor. 3 units. *Warner*

**\*395, 396. Topological Algebra.** Normed and locally convex spaces. Branch algebras. Prerequisites: Mathematics 236 and 292, or consent of the instructor. 3 units per semester. *Moore*

**\*397, 398. Seminar in Algebra and Number Theory.** Prerequisite: consent of the instructor. 3 units per semester. *Carlitz*

## Program in Medieval and Renaissance Studies

The graduate Program in Medieval and Renaissance Studies is administered by the Duke University Committee on Medieval and Renaissance Studies. For a description of the program see p. 23; for a description of individual courses see listings under the specified department.

### DEPARTMENT OF ART

**233. Early Medieval Architecture.** *Sunderland*

**234. Romanesque Sculpture.** *Sunderland*

**237. French Renaissance Art.** *Jenkins*

### DEPARTMENT OF CLASSICAL STUDIES

#### Latin

**221. Medieval Latin I.** *Newton*

**222. Medieval Latin II.** *Newton*

**225. Paleography.** *Newton*

**305. Latin Seminar V.** Prerequisite: consent of instructor. *Newton*

**306. Latin Seminar VI.** Prerequisite: consent of instructor. *Newton*

**312. Proseminar in Latin Paleography.** *Newton*

#### Classical Studies

**327. Seminar in Byzantine History.** *Rigsby*

### DEPARTMENT OF ENGLISH

**207. Old English Grammar and Readings.** *Nygard or Reiss*

**208. History of the English Language.** *Nygard or Reiss*

**210. Old English Literary Tradition.** *Nygard or Reiss*

**212. Middle English Literary Tradition.** *Nygard or Reiss*

**215, 216. Chaucer.** *Nygard or Reiss*

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\*Offered on demand.

- 221. English Prose of the Sixteenth Century.
- 222. English Non-Dramatic Poetry of the Sixteenth Century. *DeNeef*
- 223. Spenser. *DeNeef*
- 224. Shakespeare. *Williams*
- 225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*
- 229. English Literature of the Seventeenth Century. *DeNeef, Randall or Williams*
- 232. Milton.
- 310. Beowulf. *Nygard*
- 312. Studies in Middle English Literature. *Nygard or Reiss*
- 315. Studies in Chaucer. *Nygard or Reiss*
- 318. Medieval Romances. *Reiss*
- 320. Studies in Renaissance English Prose.
- 324. Studies in Shakespeare. *Williams*
- 325. Studies in the English Drama of the Sixteenth and Seventeenth Centuries. *Randall*
- 329. Studies in the Metaphysical Poets. *Williams*
- 383. Textual Criticism. *Williams*

#### DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

- 205, 206. Middle High German. *Staff*
- 215. Seventeenth Century Literature. *Borchardt*
- 216. History of the German Language. *Staff*
- 217. Renaissance and Reformation Literature. *Borchardt*

#### DEPARTMENT OF HISTORY

- 221. Problems in the Economic and Social History of Europe, 1200-1700. *Witt*
- 222. Problems in European Intellectual History, 1250-1550. *Witt*
- 237. Europe in the Early Middle Ages. *Young*
- 238. Europe in the High Middle Ages. *Young*
- 267-268. From Medieval to Early Modern England. *Ferguson*
- 351.10-352.10. Medieval Europe. *Young*
- 351.15-352.15. The English Renaissance. *Ferguson*

#### DEPARTMENT OF PHILOSOPHY

- 218. Medieval Philosophy. *Mahoney*

#### DEPARTMENT OF RELIGION

- 219. Augustine. *Gregg*
- 236. Luther and the Reformation in Germany. *Steinmetz*

241. Problems in Reformation Theology. *Steinmetz*

251. The Counter-Reformation and the Development of Catholic Dogma. *Raitt*

334. Theology and Reform in the Later Middle Ages. *Steinmetz*

336. Christian Mysticism in the Middle Ages. *Raitt*

338. Calvin and the Reformation in Switzerland. *Steinmetz*

339. The Radical Reformation. *Steinmetz*

344. Zwingli and the Origins of Reformed Theology. *Steinmetz*

## DEPARTMENT OF ROMANCE LANGUAGES

### French

213, 214. French Literature of the Seventeenth Century. *Staff*

219. Old French Literature. *Vincent*

224. History of the French Language. *Hull*

225. French Prose of the Sixteenth Century. *Tetel*

226. French Poetry of the Sixteenth Century. *Tetel*

311, 312. French Seminar (Medieval and Renaissance Topics). *Tetel and Vincent*

### Italian

284. Dante. *Fowlie*

285. Dante. *Caserta*

288. The Renaissance. *Tetel*

### Spanish

251. The Origins of Spanish Prose Fiction. *Wardropper*

252. Spanish Lyric Poetry before 1700. *Wardropper*

253. The Origin of the Spanish Theater. *Wardropper*

257. Old Spanish Language. *Davis*

258. Medieval Literature. *Davis or Garci-Gómez*

265. Cervantes. *Predmore or Wardropper*

266. Drama of the Golden Age. *Wardropper*

321, 322. Hispanic Seminar (Medieval and Renaissance Topics). *Garci-Gómez, Predmore, or Wardropper*

## Microbiology and Immunology

Professor Joklik, *Chairman* (Research Park IV); Professor Willett, *Director of Graduate Studies* (111 Research Park IV); Professors Amos, Burns, Day, Metzgar, Osterhout, and Wheat; Associate Professors C. Buckley III, R. Buckley, Nichols, Rosse, Seigler, Smith, Vanaman, Ward, and Zweerink; Assistant Professors Bolognesi, Cresswell, Dawson, Lang, Lauf, Levy, Mitchell, Scott, and Snyderman

The department offers graduate work leading to the Ph.D. degree. Specialization is possible in molecular virology, viral oncology, cell biology, microbial



physiology, immunochemistry, immunogenetics, cancer immunology, and general immunology.

Undergraduate preparation in biochemistry and physical chemistry is required. A brochure describing the Ph.D. degree program, prerequisites for admission, and research in the department can be obtained by writing the Director of Graduate Studies, Box 3020, Duke Medical Center.

**212, 213. Research Techniques in Microbiology and Immunology.** An introduction to biochemical, immunological, and cell culture techniques with emphasis on approaches to contemporary problems in molecular and cellular biology. Prerequisites: Biochemistry 247 or equivalent, and consent of instructor. Offered only in the summer. 2 units. *Dawson, Vanaman, or Staff*

**219. Molecular and Cellular Basis of Development.** See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Pathology 219, and Physiology 230.) 3 units. *Counce or Staff*

**219S. Seminar.** Optional seminar offered in conjunction with Microbiology 219.

**221. Medical Microbiology.** An intensive study of common bacteria, viruses, fungi, and parasites which cause disease in man. The didactic portion of the course focuses on the nature and biological properties of microorganisms causing diseases, the manner of their multiplication, and their interaction with the entire host as well as specific organs and cells. 4 units. *Joklik or Staff*

**233. Microbiology.** Introduction to bacteriology, virology, cell biology and immunology. Structure, metabolism and growth of bacteria, the properties of bacterial and animal viruses, and basic immunology. (Also listed as Botany 233.) 3 units. *Burns, Dawson, Joklik, or Willett*

**242. Mechanisms of Microbial Pathogenicity.** A lecture-seminar course on the principles and problems of host-parasite interactions at the cellular and molecular level. Emphasis will be on the roles of microbial structures and products in the virulence and pathogenesis of acute, chronic, and toxigenic infectious disease systems. Prerequisites: Biochemistry 247 and Microbiology 233 or equivalent. 2 units. *Wheat*

**252. General Virology and Viral Oncology.** The first half will be a discussion of the structure and replication of mammalian and bacterial viruses with special emphasis on the molecular and functional aspects. A second part will deal specifically with tumor viruses, discussed in terms of the virus-cell interaction and the response to the host. The relationship of virus infection to neoplasia will be emphasized. 4 units. *Joklik, Nichols, Smith, or Zweerink*

**282. Molecular Microbiology.** Structure, growth and replication of bacteria with a detailed analysis of informational and catalytic macromolecules. Major topics discussed are: biochemistry and function of structural components, genetic and metabolic regulatory mechanism, RNA and protein synthesis, and the enzymology of DNA replication. Prerequisite: general biochemistry. 4 units. *Burns, Leis, Nichols, or Vanaman*

**291. Basic Immunology.** Structure and function of immunoglobulins. Characteristics of synthetic and natural antigens. Specificity and cross-reactivity. Methods of immunologic analysis. Cellular aspects and kinetics of antibody formation. Forms of immunologic responsiveness and unresponsiveness. Cellular cooperation. Elicitation and control of immune responses. 3 units. *Amos, Dawson, Scott, or Snyderman*

**296. Immunochemistry.** The structures, bioassembly, and reactions of the

immunoglobulins. Primary and conformational aspects of the immunoglobulin chains—sequences, subgroups, domains, allotypes, evolution. The antibody binding site—location, specificity, idiotypes, antigen accommodation. Affinity, heterogeneity, homogeneous binding, kinetics. Sequential, conformational, and quaternary determinants. Active centers of multivalent antigens. The immune responses, affinity and immunoselection, T and B cells. 3 units. *Cresswell, Dawson, Day, or Sage*

### For Graduates

**323. Readings in Bacteriology and Immunology.** A course of readings and syntheses in restricted areas of bacteriology and immunology under the direction of individual staff members. 2 units.

**325. Medical Mycology.** Comprehensive lecture and laboratory coverage of all the fungi pathogenic for humans. Practical aspects as well as future trends in the mycology, immunology, diagnosis, pathogenesis, and epidemiology of each mycotic agent will be explored. There will be several invited lecturers, each an internationally recognized scientist, discussing their particular areas of mycological expertise and current research. Prerequisite: consent of instructor. 4 units. *Mitchell*

**330. Medical Immunology.** A course designed to present the basic concepts of immunology as they relate to human disease. Emphasis will be on tumor immunology, autoimmunity, neuroimmunology, immunohematology, and immunologic deficiency diseases. 6 units. *Levy or Staff*

**331.1-331.8. Microbiology Seminar.** Current topics in microbiology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in microbiology. 1 unit per semester. *Staff*

**332.1-332.8. Immunology Seminar.** Current topics in immunology with seminars presented by students, faculty, and outside speakers. Required course for all students specializing in immunology. 1 unit per semester. *Staff*

**336. Immunogenetics.** Antigens of tissues and organs, distribution, extraction, and chemistry. Phylogeny of iso-antigenic systems of man and animals. Tests for histocompatibility including lymphocyte interactions and reactivity. Change in antigenicity and immune responsiveness in carcinogenesis. Immunologic factors in pregnancy and in homotransplantation of organs. (Also listed under the University Program in Genetics.) 2 units. *Amos or Ward*

**420. Cellular Immunophysiology.** See course description for Physiology 420. (Also listed as Physiology 420.) 2 units. *Lauf or Staff*

## Pathology

Professor Jennings, *Chairman* (301B Medical School); Professor Sommer, *Director of Graduate Studies* (301 Medical School); Professors Fetter, Hackel, Johnston, Klintworth, Vogel, Pratt, and Wittels; Associate Professors Elchlepp, Bradford, Daniels, and Zwadyk; Assistant Professors Adams, Anderson, Bigner, Bossen, Graham, Hawkins, Shelburne, Tisher, and Reimer

The Department of Pathology offers graduate work leading to the M.S. and Ph.D. degrees with areas of specialization such as subcellular and molecular pathology. Course work is designed to give a broad background in classical and modern pathology with emphasis on the application of modern research techniques. Students will be required to take such courses as are necessary to obtain this foundation, and as are best adapted to areas of speciality and research. Further information including brochures giving details of departmental

facilities, staff, trainee stipends, and the M.D.-Ph.D. program are available from the Director of Graduate Studies.

**219. Molecular and Cellular Basis of Development.** For a description of the course see Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, and Physiology 230.) 3 units. *Counce, McCarty, or Staff*

**219S. Seminar.** Optional seminar offered in conjunction with Pathology 219.

**250. General Pathology.** The fundamentals of pathology are presented to the student. Lectures developing broad concepts of disease processes are given by the members of the senior staff. The emphasis is placed on etiology and pathogenesis of disease. Lectures. Prerequisites: histology and consent of instructor. 4 units. *Jennings or Staff*

**251. Laboratory Course in General Pathology.** Laboratory session to complement 250. Gross and microscopic material is correlated with and related to disease processes. Pathology 250 may be taken concurrently. Prerequisites: histology and consent of instructor. 4 units. *Jennings or Staff*

**258. Cellular and Subcellular Pathology.** This course is designed for students wishing to broaden their knowledge of cellular structure and cellular pathology. The course consists of lectures and seminars discussing the alterations in cellular structure and associated functions that accompany cell injury. Prerequisite: consent of instructor. Fall only. Time to be arranged. 3 units. *Hawkins, Shelburne, or Sommer*

**275. Fundamentals of Electron Microscopy.** Theoretical basis of practical electron microscopy. Areas to be discussed include the nature of light and electrons, light and electron optics, image recording and processing by photographic and other methods, specimen preparation, functional anatomy of the electron microscope, and several special techniques. Student presentations and selection of special topics will be encouraged. The approach will be non-mathematical, but college physics is strongly recommended. Practical laboratory experience will be included. Spring and fall, 1975. Fall only thereafter. 2 units. Maximum enrollment six. Time to be arranged. *Hawkins, Shelburne, or Sommer*

**325. Cardiovascular Pathology.** Cardiovascular disease processes will be studied, reviewing anatomic, embryologic, and physiologic features, and utilizing case material and gross and microscopic specimens. Consideration will be given to principles of electrocardiography. Fall only. 3 units. *Hackel*

**352. Basic Problems in Chemical Pathology.** This is an advanced seminar tutorial course in which the biochemical and physiological expressions of morphologic abnormalities will be explored. Specific organ systems will be used as a model for instruction and discussion. Experimental approaches toward solutions of problems will be discussed. Prerequisite: consent of instructor. 2 units. *Wittels*

**353. Advanced Neuropathology.** This course deals with current problems and research methods related to diseases which affect the nervous system. Prerequisite: consent of instructor. Fall only. 2 units. *Vogel*

**355, 356. Graduate Seminar in Pathology.** Discussions outlining the scope of modern pathology. This will include reports of original researchers by members of staff and visitors. Time to be arranged. 1 unit each semester. *Sommer or Staff*



**357. Research in Pathology.** Independent research projects in various fields of pathology. Time and credit to be arranged. *Jennings or Staff*

**360. Histochemistry.** Theory and application of histochemical and cytochemical techniques for investigating the presence and localization in cells of various substances such as proteins, lipids, carbohydrates, and enzymes at the light and/or electron microscopic level, including radioautography. Students will get some laboratory experience. Maximum enrollment six. Spring only. 3 units. *Hawkins, Shelburne, or Sommer*

**361, 362. Autopsy Pathology.** A detailed consideration of the morphologic, physiologic, and biochemical manifestations of disease. Emphasis is on individual work in the laboratory with tutorial supervision. Gross dissection, histologic examination, processing, and analyzing or morphologic, microbiologic, and biochemical data, and interpretation of results. Prerequisites: Pathology 250 and consent of instructor. 3-6 units per semester. *Jennings or Staff*

**364. Systemic Pathology.** Systematic presentation of the characteristics of disease processes as they affect specific organ systems in mammals. 6 units. *Hackel or Staff*

**367, 368. Special Topics in Pathology.** Special problems in pathology will be studied with a member of the senior staff; the subject matter will be individually arranged. Time to be arranged. 4 units. *Jennings or Staff*

**369. Ophthalmic Pathology.** This course will consist of lectures, seminars, and laboratory sessions. The normal anatomy and embryology of the eye will be reviewed as a basis for the study of the various ocular disease processes. The more common diseases of the eye will be considered in detail. Problems in ophthalmic pathology will be discussed together with methods of solving them. Fall only. 3 units. *Klintworth*

**370. Developmental Pathology and Teratology.** A systematic study of disease processes involving the prenatal, natal, and postnatal period. Emphasis will be placed on developmental anatomy and teratogenesis. The format includes seminars and clinicopathologic correlations derived from gross and microscopic material. Prerequisites: Pathology 350, anatomy, and histology. Fall only. 3 units. *Bradford*

**373. Cytopathology.** This course is designed to present the principles and techniques by which basic cytology is applied to the diagnostic interpretation of disease. Classroom and laboratory work will include diseases involving the female genital tract, respiratory tract, urinary tract, effusions, gastrointestinal tract, and central nervous system. Neoplastic disease will be emphasized. Practical application of the acquired knowledge will be made in examining current material. Prerequisites: Pathology 350, 351, or consent of instructor. Fall. 3 units. *Johnston or Staff*

**374. Pulmonary Pathology and Postmortem Pathophysiology.** Emphasis will be on pulmonary pathology and pathophysiology of infectious, metabolic, environmental, and neoplastic diseases, and certain diseases of unknown etiology (e.g., sarcoid, alveolar proteinosis, etc.). Ventilatory experiments will be done on excised human lungs. Fall. 3 units. *Pratt*

**377. Pathology of the Kidney.** The course includes a comprehensive study of pathological, immunological, and clinical features of the glomerulonephritides, the nephrotic syndrome, and pyelonephritis, as well as of metabolic, congenital, and neoplastic renal disorders. Lectures will be supplemented with



gross and microscopic specimens, demonstrations, and special library studies. Fall. 3 units. *Tisher or McCoy*

**378. Immunopathology.** A study of human diseases in which the immune system plays an important role. A series of lectures, seminars, and studies of human case materials. Fall. 4 units. *Adams, Bigner, Bossen, or Daniels*

**379. Pathology of Virus Infections.** The pathological effects of viruses will be discussed. A series of lectures and student-conducted seminars concerning the structural, biochemical, and functional alterations associated with virus-cell interactions. Spring. 4 units. *Bigner or Daniels*

## Philosophy

Professor Peach, *Acting Chairman* (201E West Duke Building); Associate Professor Roberts, *Director of Graduate Studies* (201B West Duke Building); Professor Welsh; Associate Professors Mahoney and Sanford; Assistant Professor Ross; Visiting Professor Nowell-Smith; Visiting Assistant Professors Bamford and Boudreaux

The Department of Philosophy offers graduate work leading to the A.M. and Ph.D. degrees. Tutorial work complements formal instruction. Students may specialize in any of the following fields: the history of philosophy, logic, philosophy of science, epistemology, metaphysics, philosophy of mind, philosophy analysis, ethics, aesthetics, political philosophy, philosophy of law, and philosophy of religion.

Individual programs of study are developed for each student. The following requirements, however, are fundamental: (1) In February of their first year new graduate students are required to take one or two qualifying examinations, diagnostic in purpose. One examination tests his ability to deal critically and systematically with some basic philosophical topic; a second examination, in logic, is required of anyone who has not taken a graduate-level logic course during his first term. (2) The preliminary examination for the Ph.D., which may be taken only after a student has met the language requirement for that degree, should be taken after the second year of study. In these examinations students are expected to combine historical knowledge with critical understanding.

Work in a minor or related field, not necessarily confined to any one department, is encouraged but not required. A minor normally includes 6 units for the A.M. or the Ph.D. degree and may include more as a student's program requires or permits.

A student who meets the general requirements of the Graduate School for the A.M. degree may earn this degree by satisfying the foreign language requirement and by passing the preliminary examination for the Ph.D. degree or by writing and successfully defending a master's thesis.

A reading knowledge of at least one foreign language, ancient or modern, is required for the Ph.D. degree. No student may take his preliminary examination until he has demonstrated this ability. More than one language may be required where this is judged appropriate to the research demanded by the candidate's dissertation.

### For Seniors and Graduates

**202. Aesthetics: The Philosophy of Art.** A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music and painting. Problems discussed include the role of standards in criticism,

aesthetic judgment, interpretation, evaluation in the arts, meaning in the arts, art and truth, the arts and morality. Open to juniors with the consent of the instructor. One course. (3 graduate units.) *Welsh*

**203. Contemporary Ethical Theories.** Study of the nature and justification of basic ethical concepts in the light of the chief ethical theories of twentieth century British and American philosophers. One course. (3 graduate units.) *Roberts*

**204. Philosophy of Law.** Natural law and theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. One course. (3 graduate units.) *Staff*

**205. Philosophy of History.** The nature of historical knowledge and inquiry; theories of the historical process. One course. (3 graduate units.) *Nowell-Smith*

**206. Topics in Ethical Theory.** One course. (3 graduate units.) *Staff*

**208. Political Values.** Analysis of the systematic justification of political principles and the political values in the administration of law. One course. (3 graduate units.) *Staff*

**211. Plato.** A critical study of selected dialogues, with emphasis on problems in epistemology and metaphysics. One course. (3 graduate units.) *Mahoney*

**217. Aristotle.** A study of passages from the *Organon*, *Physics*, *De Anima*, and *Metaphysics*. One course. (3 graduate units.) *Mahoney*

**218. Medieval Philosophy.** Selected problems in medieval philosophy. One course. (3 graduate units.) *Mahoney*

**225. British Empiricism.** A critical study of the writings of Locke, Berkeley, or Hume with special emphasis on problems in the theory of knowledge. One course. (3 graduate units.) *Peach*

**227. Continental Rationalism.** A critical study of the writings of Descartes, Spinoza, or Leibniz with special emphasis on problems in the theory of knowledge and metaphysics. One course. (3 graduate units.) *Peach*

**228. Recent and Contemporary Philosophy.** A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. One course. (3 graduate units.) *Welsh*

**230. The Meaning of Religious Language.** See course description for Religion 230. (Also listed as Religion 230.) 3 units. *Potest*

**231. Kant's Critique of Pure Reason.** One course. (3 graduate units.) *Staff*

**232. Recent Continental Philosophy.** Selected topics. One course. (3 graduate units.) *Staff*

**233. Methodology of the Empirical Sciences.** Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Prerequisite: consent of the instructor. One course. (3 graduate units.) *Ross*

**234. Problems in the Philosophy of Science.** Selected problems in the physical and nonphysical sciences such as space and time, measurement and determinism. Prerequisite: consent of the instructor. One course. (3 graduate units.) *Ross*

**241. Symbolic Logic.** Detailed analysis of deduction and of deductive systems. One course. (3 graduate units.) *Staff*

**251. Epistemology.** Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism, and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. One course. (3 graduate units.) *Sanford*

**252. Metaphysics.** Selected topics: substance, qualities and universals, identity, space, time, causation, and determinism. One course. (3 graduate units.) *Sanford*

**253. Philosophy of Mind.** Analysis of concepts such as thought and belief; issues such as mind-body relations, thought and action, the nature of persons and personal identity. One course. (3 graduate units.) *Roberts*

**254. Philosophy of Religion.** Topics such as proofs of the existence of God, meaningfulness of religious language, the problem of evil, immortality and resurrection. One course. (3 graduate units.) *Roberts*

**255. Philosophy of Action.** Problems in the individuation, characterization, and explanation of human actions; an analysis of such concepts as choosing, deciding, intending, doing, making, letting. One course. (3 graduate units.) *Sanford*

**260. Wittgenstein.** An examination of the *Tractatus* or the *Investigations*. One course. (3 graduate units.) *Welsh*

**287, 288. Foundations of Mathematics.** See description for Mathematics 287, 288. (Also listed as Mathematics 287, 288.) One course. (3 graduate units.) *Shoenfield*

**291, 292. Seminar in Special Fields of Philosophy.** One course. (3 graduate units.) *Graduate Staff*

## For Graduates

**331, 332. Seminar in Special Fields of Philosophy.** 3 units. *Graduate Staff*

## Physical Therapy

Associate Professor Branch, Acting Co-Chairman and Director of Graduate Studies (045 Hospital); Associate Professor Villaneuva

The Department of Physical Therapy offers a basic professional program leading to the M.S. degree. To be eligible for admission to the program, applicants must have obtained a baccalaureate degree and have a background in the basic sciences and social sciences including course work in biology, chemistry, physics, psychology, and statistics. In the first year of the curriculum students are required to take courses in anatomy and physiology, offered by those respective departments. Further information may be obtained from the Director of Graduate Studies, Department of Physical Therapy, Box 3965, Duke University Medical Center.

**201, 202. Seminar in Physical Therapy.** Historical background and trends in the profession; orientation to physical therapy departmental organization and administration; professional and community relationships; professional ethics; methods of communication; and literature review. Units by arrangement. *Villaneuva and Staff*

**217. Physical Therapy Dynamics I.** Orientation to patient care; principles of biomechanics and applied anatomy; introduction to microscopic anatomy. 3 to 4 units. *Branch, Villaneuva, or Staff*

**218. Physical Therapy Dynamics II.** Regional approach to the process of human movement analysis, including kinesiological analysis of normal and pathological patterns of gait; introduction to therapeutic exercise, with emphasis on rationale and methods of treatment; principles and practice of physical therapy procedures, with emphasis on biophysical and physiological considerations for utilization of selected therapeutic agents: mechanical, thermal, chemical, and electrical. 5 units. *Branch, Villaneuva, or Staff*

**220. Physical Therapy Dynamics III.** The role of the central nervous system in the inhibition or facilitation of motor behavior as related to the management of patients with central nervous system disorders. Emphasis on the application of current neurophysical concepts to the evaluation of patients with central nervous system deficits and to the planning and administration of treatment programs. 2 to 4 units. *Villaneuva or Staff*

**230, 231. Physical Evaluation and Instrumentation.** Principles and techniques of objective assessment and analysis of functional status, including manual muscle tests, dynamometry, goniometry, electrical diagnostic testing, posture analysis, body measurements, evaluation of respiratory and sensory function, disability evaluation, and orientation to electromyography and nerve conduction studies. 2-4 units per semester. *Staff*

**234. Introductory Pathology.** Fundamentals of pathology with emphasis on broad concepts of disease processes; systems of the body are studied from the point of view of histological and functional change. 3 units. *Branch and Special Lecturers*

**236. Medical Sciences.** Lectures by clinicians with patient demonstrations and correlation of treatment methods; medical and surgical, neurological, orthopaedic, and emotional conditions affecting human dysfunction; emphasis on psychodynamic principles of patient-therapist relationships. 4 units. *Staff and Special Lecturers*

**238. Introduction to Health Service Systems.** Political, economic, and sociocultural aspects of the organization of health care systems; structural components and interrelationships; criteria for assessing and analyzing health care systems. 2 to 3 units. *Staff*

**240. Prosthetics and Orthotics.** Designed to provide basic knowledge of the effects of prostheses and orthoses on trunk and extremity function, in relation to various skeletal and neuromuscular disorders. Includes components and materials; design and fabrication; principles of fit, alignment and operation of device; evaluation; gait and activities training procedures. 2-4 units. *Villaneuva and Staff*

**242. Directed Clinical Experience in Physical Therapy I.** Students are assigned to hospitals, rehabilitation centers, schools for crippled children, extended-care facilities, and public health units for short-term supervised learning experience. 1 to 2 units. *Staff*

**243, 244. Directed Clinical Experience in Physical Therapy II.** Students are assigned to full-time learning experiences under direction. 2-4 units per semester. *Staff*

**297-298. Special Topics in Physical Therapy.** Special problems in physical therapy will be studied with a faculty member; the subject matter will be individually arranged. Units to be arranged. *Branch or Staff*

**301. Introduction to Scientific Inquiry.** Theory and use of analytical meth-



ods of problem-solving; elements of scientific writing; preparation of a research protocol and a major paper. 3 units. *Staff*

**315. Curriculum Development.** Introduction to learning theory; development of objectives, organization, course content, and evaluation in physical therapy education. 2 to 3 units. *Staff*

**316. Directed Teaching in Physical Therapy.** 1 to 3 units. *Staff*

**320. Sensorimotor Mechanisms Related to Rehabilitation.** Development of normal motor behavior, and structural and functional organization of the nervous system related to methods of facilitating functional capacities for performing the activities of daily living. 2 to 3 units. *Villaneuva or Staff*

**322. Case Conferences in Rehabilitation.** Observation and demonstration of care of patients with extensive disability; emphasis on integration of health services for comprehensive care via the case conference approach. 1 to 2 units. *Staff*

**332. Administration of Physical Therapy Services.** Principles of administration, leadership styles, and management roles; concepts of systems theory and analysis; planning, organizing, delivering, and evaluating physical therapy systems and subsystems. 3 units. *Staff*

**341-342. Advanced Seminar—Selected Problems.** 2 to 3 units. *Staff*

**350. Research.** Units by arrangement. *Staff*

## Physics

Professor Walker, *Chairman* (119 Physics Building); Associate Professor Evans, *Director of Graduate Studies* (111 Physics Building); Professors Biedenharn, Bilpuch, Fairbank, Gordy, Lewis, Meyer, Newson, Roberson, Robinson, and Walter; Adjunct Professors O'Foghludha, Robl and Way; Associate Professors Cusson, Fortney, Han; Assistant Professors DeLucia, Friedman, Goshaw, Lawson, Lisowski, Loos, and Smith

The Department of Physics offers graduate work for students wishing to earn the A.M. or Ph.D. degree. In addition to a balanced program of basic graduate courses, the department offers specialized courses and seminars in several fields, in which research is being done by students, faculty, and staff.

With the help of faculty advisers, each student selects a course program to fit his needs, including work in a related field, usually mathematics or chemistry. Students are encouraged to begin research work early in their career.

The department does not ordinarily accept students for work toward the A.M. degree only, and students making good progress are advised to work directly for the Ph.D. degree. The option of taking the A.M. without thesis is available with the approval of a departmental committee.

A reading knowledge of one language, usually chosen from French, German, or Russian, is required for the Ph.D. degree.

### For Seniors and Graduates

**211, 212. Advanced Modern Physics.** Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161, 181 or equivalents. Mathematics 285-286 or equivalent (may be taken concurrently). Two courses. (6 graduate units.) *Robinson*

**215. Introduction to Quantum Mechanics.** Wave mechanics and elementary

applications; the hydrogen-like atoms; electron spin and angular momentum; operators and eigenvalues; stationary state perturbation theory; identical particles. Prerequisites: courses in modern physics and intermediate mechanics; Mathematics 285-286 may be taken concurrently. One course. (3 graduate units.) *Evans*

**217S, 218S. Advanced Physics Laboratory and Seminar.** Experiments involving the fields of mechanics, electricity, magnetism, heat, optics, and modern physics. Two courses. (6 graduate units.) *Meyer*

**220. Electronics.** Basic elements of modern electronics including a.c. circuits, transfer functions, solid state service, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. One course. (3 graduate units.) *Fortney*

**223. Electricity and Magnetism.** Electrostatic fields and potentials, boundary value problems, magnetic induction, energy in electromagnetic fields, Maxwell's equations, introduction to electromagnetic radiation. One course. (3 graduate units.) *Loos*

**268. Mathematical Foundations of General Relativity.** (Also listed as Mathematics 268.) One course. (3 graduate units.) *Cantor*

**280. Nuclear Reactor Physics.** Neutron diffusion theory, reactor criticality, kinetics, control, and reactivity effects. Slowing-down of neutrons, age theory, resonance absorption, temperature effects, and multigroup methods. Prerequisites: Physics 161; Mathematics 285-286 or equivalent (may be taken concurrently). One course. (3 graduate units.) *Cusson*

**282. Mechanics of Continuous Media.** Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41-42 or 51-52 and differential and integral calculus. One course. (3 graduate units.) *Walker*

## For Graduates

**302. Advanced Mechanics.** The fundamental principles of Newtonian mechanics; general dynamics of systems of particles and rigid bodies; the methods of Lagrange and Hamilton; generalized mechanics. 3 units. *Cusson*

**303. Statistical Mechanics.** Fundamental laws of thermodynamics and statistical mechanics with applications to physics and chemistry. Classical and quantum ideal gases; approximate methods for real gases and liquids. Prerequisite: Physics 215. 3 units. *Friedman*

**\*304. Advanced Topics in Statistical Mechanisms.** This course will vary from year to year. Possible topics include Fermi liquids, systems of bosons, many-body theory, non-equilibrium statistical mechanics. Prerequisites: Physics 303 and 316. 3 units.

**305. Introduction to Nuclear Physics.** Phenomenological aspects of nuclear physics; interaction of gamma radiation and charged particles with matter; nuclear detectors; particle accelerators; radioactivity; basic properties of nuclei; nuclear systematics; nuclear reactions, particle scattering; nuclear models of the deuteron; nuclear forces; parity. 3 units. *Roberson*

**\*306. Low Temperature Physics.** The properties of matter near the absolute zero of temperature; superconductivity, liquid helium, adiabatic demagnetization. Prerequisite: Physics 303. 3 units. *Fairbank*

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\*Offered on demand.

**308. Introduction to High Energy Physics.** High energy processes; electromagnetic, weak, and strong interactions. 3 units. *Walker*

**309. Solid State Physics I.** Properties of matter in the condensed state; crystal lattices, electrons in metals and semiconductors, band theory, non-metallic solids, lattice dynamics, and phonons. Prerequisites: Physics 215 and 303. 3 units.

**\*310. Solid State Physics II.** Elementary excitations and their interactions in the condensed state of matter; scattering theory and correlation functions; magnetic interactions in solids, superconductivity; amorphous solids. Prerequisites: Physics 309 and 316. 3 units.

**312. Phase Transitions and Critical Phenomena.** Description of phase transitions in diverse physical systems such as fluids, magnets, mixtures, and superfluids. Experimental techniques and results. Application of the classical methods of thermodynamics, correlation functions, and mean field theory to the critical state of matter. Microscopic models of phase transitions. Modern approaches to static and dynamic critical phenomena such as the theories of critical exponents, scaling, series expansions, critical relaxation, and mode-mode coupling. 3 units.

**316. Principles of Quantum Theory.** Original and fundamental concepts of quantum theory; wave and matrix mechanics; theory of measurements; exclusion principle and electronic spin. Prerequisite: Physics 302. 3 units. *Evans*

**317. Intermediate Quantum Theory.** General operator methods; angular momentum; Dirac electron theory. Second quantization; symmetry principles and conservation theorems. Applications to the theory of solids, of nuclei, and of elementary particles will be stressed. Prerequisite: Physics 316. 3 units. *Biedenharn*

**318. Electromagnetic Field Theory.** Electrodynamics; theory of wave optics; radiation of electric and magnetic multipole fields; special relativity; covariant electrodynamics; Lienard-Wiechert potentials; scattering and dispersion; Hamiltonian field equations. Prerequisite: Physics 223. 3 units per semester.

**\*330. Nuclear Structure Theory.** Two body nuclear forces used to describe nuclear structure; nuclear shell and collective models; properties of nuclear levels; magnetic and quadrupole moments; transition probabilities; nucleon-nucleon scattering; nuclear reactions. Prerequisites: Physics 305 and 316. 3 units.

**\*331. Microwave Radiation.** Microwave generators, cavity resonators, transmission lines, radiation propagation, and detection. 3 units. *Gordy*

**\*335. Microwave Spectroscopy.** Application of microwaves in the determination of molecular, atomic, and nuclear properties. Stark and Zeeman effects in microwave spectroscopy. Magnetic resonance absorption. 3 units. *Gordy*

**\*341. Advanced Topics in Quantum Theory.** Introduction to relativistic quantum field theory; Lorentz and Poincare groups; quantization of free fields; interacting fields and S-matrix; applications of quantum electrodynamics and dispersion relations. Prerequisite: Physics 317. 3 units.

**\*342. Theory of Elementary Particles.** Theoretical methods used in treating particle interactions, emphasizing phenomenological treatments. Quantum field theory and dispersion theory is developed as needed. Applications in the general areas of pion physics, electromagnetic interactions of hadrons, strange

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\*Offered on demand.

particle interactions, and weak interactions are surveyed. Prerequisite: Physics 316. 3 units. *Han*

**\*343. Nuclear Physics.** Elementary theory of the deuteron; low energy neutron-proton scattering; theory of nuclear reactions; penetration of potential barriers; nuclear energy levels. Prerequisite: Physics 215. 3 units. *Newson*

**\*344. Advanced Nuclear Physics.** The deuteron, nuclear forces, scattering of elementary particles, beta-radiation. Other aspects of nuclear physics amenable to theoretical interpretation. 3 units. *Biedenharn*

**\*345. High Energy Physics.** Experimental and theoretical aspects of high energy nuclear processes; properties of mesons and hyperons. 3 units.

**\*346. Topics in Theoretical Physics.** The content of this course will vary from year to year. General methods in quantum mechanics such as group theory and its applications; elementary particle theory; field theory; theory of solids; theoretical nuclear physics; atomic and molecular structure. Prerequisites: Physics 316, 317. 3 units.

**351, 352. Seminar.** A series of weekly discussions on topics related to the research projects under investigation in the department. 2-4 units. *Graduate Staff*

**397, 398. Low Temperature and Solid State Seminar.** Weekly seminar on advanced topics and recent research work in the field of low temperature and solid state physics. 2-4 units.

## Physiology and Pharmacology

Associate Professor Salzano, *Acting Chairman* (388 Medical Sciences I); Professor Ottolenghi, *Director of Graduate Studies* (425 Medical Sciences I); Professors Bernheim, Blum, Hitchings, Jobsis, Johnson, Lack, Maxwell, Moore, Narahashi, Nichol, Schanberg, and Somjen; Associate Professors Anderson, Fellows, Gutknecht, Kylstra, Lauf, Lieberman, McManus, Mendell, Menzel, Mills, Padilla, Posner, Slotkin, Spach, and Wolbarsht; Assistant Professors Carter, Duran, Ellinwood, Greenfield, Hall, Kootsey, Lebovitz, Mandel, Namm, Ramon, Rosen, Rosenthal, Schomberg, Schooler, Wachtel and Wallace

The Department of Physiology and Pharmacology offers graduate work leading to the Ph.D. degree. Before undertaking this program a student should have a strong background in basic sciences including course work in mathematics, biology, physics, and chemistry through physical chemistry. Undergraduates with this background may have majors in any of the following areas: biology, chemistry, physics, or engineering. There is no foreign language requirement. All graduate students are required to take the introductory courses in both physiology and pharmacology. A brochure which describes the program of study, facilitates, and research activities of the staff is available from the Director of Graduate Studies.

### For Seniors and Graduates

**200. Introduction to the Physiology of Man.** Lectures and conferences on cell and organ physiology. Human and medical aspects are stressed in clinical conferences and in laboratory experience. The neurophysiology section is given in a three-week period following the end of the semester. Limited to students whose training requires knowledge of human physiology as it pertains to medi-

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\*Offered on demand.



cine. Three lectures, two conferences and one laboratory per week. Prerequisites: consent of the course leader. Fall. 7 units. *Jobsis and Staff*

**204. Introduction to Modern Physiology.** Topics such as flow of fluids in tubes, ionic transport mechanisms, and endocrine systems are examined in terms of how such processes enter into the functioning of intact organs such as heart, lung, gut, and central nervous system. Particular emphasis is given to the control of physiological function both at the cellular and higher levels of organization. Required of all graduate students in physiology and pharmacology. Others must have consent of instructor. Prerequisite: at least one year of physics, calculus, biology, and chemistry through organic chemistry. Physical chemistry is strongly recommended. Fall. One course. (4 graduate units.) *Blum or Staff*

**208. Respiratory System in Health and Disease.** Primary emphasis on the physiology of respiration. Topics include pulmonary mechanics, gas exchange, ventilation-perfusion relationships, central and peripheral regulation of ventilation and respiratory responses to exercise, altitude, and hyperbaric environments. Spring. 2 units. *Salzano and Kylstra*

**210, 211. Individual Study and Research.** Directed reading and research in physiology and pharmacology. Prerequisites: senior standing and consent of the Director of Graduate Studies. Fall and spring. 3 to 9 units per semester. *Staff*

**212. Membrane Physiology and Osmoregulation.** Physiology of marine and estuarine organisms, with emphasis on cellular transport and electrophysiology. Includes the functions, mechanisms, and comparative aspects of ionic and osmotic regulation in aquatic plants and animals. Laboratory work deals with membrane transport in single cells and epithelia, renal and gill transport in fish, amino acid transport and metabolism in crustaceans, and application of radiotracer and other physical and chemical techniques to the study of membrane function. Prerequisite: consent of instructor. Summer. 6 units. *Gutknecht and Staff*

**215. Topics in Developmental Physiology.** The physiological basis of development at the organ level with special reference to vertebrates. Development of neuronal connections, cardiogenesis, hormonal regulation, and cellular interactions in organogenesis. Prerequisite: consent of instructor. Alternate years beginning spring, 1977. 2 units. *Lieberman, Mendell, or Padilla*

**216. Contractile Processes.** Cellular basis of activity in cilia and skeletal, cardiac, and smooth muscle; submicroscopic structure and behavior of muscle; special properties of muscle membranes; the problem of electro-mechanical coupling; mechanics, thermodynamics, and biochemistry of muscular contraction; developmental and adaptive changes in function. Prerequisite: consent of instructor. Alternate years beginning fall, 1976. (Also listed as Anatomy 215.) 3 units. *Anderson, Jobsis, Johnson, or Reedy*

**217. Membrane Transport.** Chemical composition and ultrastructure of biological membranes, ionic and osmotic equilibria across the membranes of individual cells, passive and active ionic transport, the role of ATPase, carrier-mediated diffusion of non-electrolytes, integration of transport processes to produce molecular movements across organized epithelia, e.g. amphibian skin and bladder, and gastrointestinal mucosa. Prerequisite: consent of instructor. Fall. 3 units. *Hall, Lauf, Mandel, or Simon*

**220. Physiology of Exercise.** Physiological principles of organ systems involved in physical exercise. Physiological limits in normal health; selected

pathological states; illustrative aspects of physical therapy. For students of physical therapy. Not recommended for students who have taken Physiology 200, 202, or equivalent. Prerequisite: an undergraduate course in organ physiology and consent of instructor. Spring. 2 units. *Jobsis and Staff*

**222. Marine Electrobiolgy.** The physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysical studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. Ionic basis of bioelectric signals, transmission of signals within and between cells, relation of bioelectric signals to particular behavioral patterns, effects of externally applied electric fields, bioelectric communication, and navigation systems. Prerequisites: consent of instructor. Summer at Beaufort. (Also listed as Biomedical Engineering 252.) 6 units. *Wachtel and Wolbarsht*

**225. An Introduction to Neuronal Physiology and Pharmacology.** The properties of excitable membrane in qualitative terms, including impulse generation and conduction in different types of nerves, the effects of pharmacological agents on electrical properties of membranes, the physiological and pharmacological aspects of synaptic and neuromuscular transmission, and biophysics of receptor cells. Electrophysiological techniques are presented in Physiology 386 which supplements this course. Advanced quantitative approaches to membrane biophysics including voltage clamp techniques are covered in Physiology 416. Fall. 3 units. *Narahashi, Moore, Wachtel, or Wolbarsht*

**230. Molecular and Cellular Basis of Development.** See course description for Anatomy 219. (Also listed as Anatomy 219, Biochemistry 219, Microbiology 219, and Pathology 219.) Fall. *Counce, Johnson, Kaufman, McCarty, or Padilla*

**230S.** Optional seminar offered in conjunction with Physiology 230.

**250. Pharmacology: Mode of Action of Drugs.** The pharmacological action of drugs in terms of biochemical and physiological processes. Three lectures and one conference per week. Prerequisite: Physiology 200 or equivalent. Spring. 4 units. *Menzel or Staff*

**252. Cellular and Chemical Pharmacology.** Chemical aspects of cell-drug interaction and structure-activity relationships. Stereochemistry. Cholinergic and adrenergic mechanisms. Drug design. Alternate years beginning fall, 1977. 3 units. *Ottolenghi or Staff*

**254. Mammalian Toxicology.** Principles of toxicology as related to man. Emphasis on the molecular basis for toxicity of chemical and physical agents. Subjects include the limitations and assumptions of extrapolation to man from animal toxicity, safety drugs and good additives, toxicity of pesticides and their hazard to man, and the role of scientists in societal decisions on the use of man-made chemical and physical agents. Prerequisite: consent of instructor. Fall. 3 units. *Menzel or Staff*

**256. Human Nutrition.** Nutrition principles with emphasis on physiology and pharmacology. Topics include the chemical basis for nutrient requirements, application to practical diets, parenteral nutrition, influence of dietary intake on disease (cardiovascular disease, diabetes, and inborn errors of metabolism), optimal dietary intake, impact of food technology on human nutrition, growth, maturation, and lactation and their requirements and recent advances in micronutrient requirements. Prerequisite: consent of instructor. Fall. 2 units. *Menzel*

**280. Student Seminar in Physiology and Pharmacology.** Preparation and presentation of seminars to students and faculty on topics of broad interest to physiology and pharmacology. Required of all physiology and pharmacology graduate students. Fall and spring. 2 units. *Bernheim*

**281. Teaching Methods in Physiology.** Participation with departmental staff in various teaching modes. Lectures, conferences, tutorials and preparation of self-instructional teaching materials. Available only to graduate students in the Department of Physiology and Pharmacology. Fall, spring and summer terms. Credits to be arranged. *Staff*

**282. Teaching Methods in Pharmacology.** Participation with departmental staff in various teaching modes. Lectures, conferences, tutorials and preparation of self-instructional teaching materials. Available only to graduate students in the Department of Physiology and Pharmacology. Fall, spring and summer terms. Credits to be arranged. *Staff*

### **For Graduates**

**311. Physiological Basis of Medicine.** Clinical presentations followed by detailed examination of the underlying physiological dysfunction. Topics include obstructions of hollow viscera, calcium and potassium homeostasis, temperature regulation, spinal cord injury, tissue oxygenation. Fall. 3 units. *Somjen or Staff*

**321. Gastrointestinal and Renal Physiology.** Mechanisms of intestinal secretion, digestion, absorption, and motility, and their control at a cellular level. Basic renal mechanisms involved in the elaboration of urine including concentrating and diluting mechanisms, hemodynamics, and regulation of acid-base balance. Spring. 3 units. *Jones and Yarger*

**330. Pharmacological Basis of Clinical Medicine.** This course consists of a detailed analysis of the mechanisms of action and rationale for use of pharmacologic agents in disease states. Fall. 4 units. *Schanberg or Staff*

**331. Laboratory Methods in Pharmacology.** Tutorial laboratory training in various fields of pharmacology including neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and biophysical pharmacology. Certain special laboratory sessions are conducted at the Wellcome Research Laboratories of the Burroughs Wellcome Company, Research Triangle Park. Prerequisite: consent of instructor. Fall and spring. 3 to 6 units. *Narahashi, Maxwell, and Staff*

**334. Pharmacodynamics.** Introduction to the fundamentals of physical processes in biological systems as they pertain to drug action. Topics include pharmacokinetics, drug absorption, distribution, metabolism and excretion, receptor theory, Hansch correlation of molecular structure with biological activity, and molecular orbital theory. Alternate years beginning fall, 1976. 3 units. *Rosen or Slotkin*

**335. Drug Receptor Theory.** Development of receptor theory from the standpoint of kinetic models; adaptation of theory to the qualitative evaluation of receptors by biochemical, physiological, and pharmacological criteria. Prediction of receptor properties. (Receptors of the autonomic nervous system and hormone responsive cells will be emphasized.) Spring only. 2 units. *Rosen*

**362. Current Topics in Cardiac Muscle Physiology.** Selected topics in the physiology and pharmacology of cardiac muscle, including general and comparative morphology and ultrastructure, cardiac electrophysiology and mechanics, and excitation-contraction coupling. Spring. 2 units. *Johnson or Staff*



**372. Research in Physiology and Pharmacology.** Laboratory investigation in various areas of physiology and pharmacology. Fall and spring. Credits to be arranged. *Staff*

**383. Physiological Instrumentation.** Electronic methods of measurement of physiological variables. The operational amplifier is used as the active building block in appropriate feedback circuits containing only passive elements to make a wide range of linear instruments including analog computers. Digital logic and computing elements are also developed. Alternate years beginning spring, 1977. 3 units. *Moore or Staff*

**386. Laboratory Methods in Electrophysiology.** Laboratory training in the proper use of apparatus for stimulation recording and analysis of electrical activity of nerve, muscle, and other tissues. Designed to supplement Physiology 225. Prerequisite: Physiology 225 or equivalent. Fall. 3 units. *Anderson, Kootsey, Lieberman, Mandel, Mendell, Moore, Narahashi, Wachtel, or Wolbarsht*

**393. Integrative and Clinical Neurophysiology.** Aspects of the physiology and pharmacology of the central nervous system in health and in disease: sensory coding; reflex functions; motor control; effects of drugs on the CNS; physiological aspects of memory. Spring. 3 or 4 units. Extra unit available upon consent of instructor. *Somjen or Staff*

**401. Metabolic and Developmental Physiology.** Cell division and control of the cell cycle; population dynamics; physiology of subcellular organelles such as nuclei, mitochondria, lysosomes, and peroxisomes; metabolic regulation. Prerequisite: Biochemistry 247 or equivalent. Fall. 3 units. *Blum, Padilla, or Staff*

**414. Analysis of Physiological Systems.** Several physiological systems analyzed in detail, using a combination of classical mathematical analysis, model-building, and newer analog and digital techniques. Topics covered include diffusion processes, steady state and transient kinetics, and cable equations. Alternate years beginning spring, 1977. 3 units. *Blum, Moore, or Staff*

**416. Biophysics of Excitable Membranes.** Advanced quantitative approach to bioelectric membrane phenomena. Topics include the cable properties of axons, voltage clamping theory and techniques, the ionic mechanisms of excitation, mechanisms of synaptic and neuromuscular transmission, receptor mechanisms, models of membranes and neurons, and the pharmacology of excitable membranes. Prerequisite: Physiology 225 or equivalent; a background in calculus, physics, and physical chemistry is recommended. Alternate years beginning fall, 1976. 3 units. *Moore, Narahashi, Wachtel, or Wolbarsht*

**417. Cellular Endocrinology.** Current concepts of the mechanisms of action of hormones at the cellular level, including hormone-receptor interactions; secondary messenger; regulation of protein synthesis; growth and differentiation; control of salt and water balance; regulation of substrate storage and mobilization; modulation of hormone secretion. Fall. 2 units. *Fellows or Lebovitz*

**418. Reproductive Biology.** An in-depth survey of male and female reproductive processes including neuroendocrine, pituitary and gonadal control mechanisms, and the physiology of pregnancy and parturition. (Also listed as Anatomy 418.) Spring. 2 units. *Anderson, Blake, Fletcher, Schomberg, or Tyrey*

**419. Topics in Mathematical Physiology.** Microcirculatory models, biological wave propagation, and dimensional analysis and scaling. Prerequisite:



consent of instructor. Alternate years beginning spring, 1978. 3 units. *Blum, Kootsey, or Moore*

**420. Cellular Immunophysiology.** The interaction of antibodies or plant agglutinins with membrane surfaces and the resulting effects on membrane function and cell physiology. Emphasis on permeability changes in red blood cells and certain nucleated mammalian cells mediated by immune reactions as well as on antibody induced alterations of enzyme activities. (Also listed as Microbiology 420.) Spring. 2 units. *Lauf*

**422. Advanced Seminar in Endocrinology and Reproductive Physiology I.** A weekly seminar based on student and faculty-led discussions of special topics in endocrinology and reproduction. Primarily designed for advanced students with active research interests relating to these areas of mammalian physiology. Prerequisite: consent of instructor. Fall. 2 units. *Anderson, Bell, Everett, Fellows, Lebovitz, Schomberg, and Tyrey*

**423. Advanced Seminar in Endocrinology and Reproductive Physiology II.** A continuation of Physiology 422 with discussion of topics not covered in the fall term. Prerequisites: Physiology 422 and consent of instructor. Spring. 2 units. *Anderson, Bell, Everett, Fellows, Lebovitz, Schomberg, and Tyrey*

## Political Science

Professor Barber, *Chairman* (214 Perkins Library); Associate Professor Johns, *Director of Graduate Studies* (308 Perkins Library); Professors Braibanti, Cleveland, Grzybowski, Hall, Hallowell, Holsti, Hough, Kornberg, and Leach; Associate Professors Fish, Hawley, Paletz, Price, Rogowski, and Spragens; Assistant Professors Eldridge, McKean, Mishler, Salamon, and Valenzuela; Lecturers O'Barr and Stone

The Department of Political Science offers graduate work leading to the A.M. and Ph.D. degrees. Before being admitted to candidacy for the Ph.D. degree, an applicant is normally expected to have qualified for the A.M. degree.

Instruction is designed to prepare the student for teaching and research, for government service, and for other work related to public affairs. Before undertaking graduate study in political science, a student is ordinarily expected to have completed at least 12 semester hours of course work in political science, including some work in American government. Fields in which instruction is offered currently are American government and politics, comparative government and politics, political theory, international relations, and empirical theory and methodology.

The candidate for the degree of Doctor of Philosophy in political science must take at least twelve courses in the department and demonstrate competence in at least three general fields of the discipline as well as in a fourth general field or in a specialized sub-field or in a field external to the department. He must also demonstrate a reading knowledge of two foreign languages or he must demonstrate proficiency in one such foreign language and in the use of statistics.

Further details on the graduate program in political science, the departmental facilities, the staff, and available financial aid may be obtained from the Director of Graduate Studies, Department of Political Science.

### For Seniors and Graduates

**204. Ethics in Political Life.** Ethical issues arising in the conduct of political vocations and activities. (Also listed as Public Policy Science 204.) One course. (3 graduate units.) *Spragens*

**206. Politics and the Media.** The relationship between the media of mass communication and the American political process. Open to upperclassmen with consent of instructor. One course. (3 graduate units.) *Paletz*

**207. American Constitutional Interpretation.** Development of the constitution of the United States through Supreme Court decisions. Prerequisite: Political Science 127. One course. (3 graduate units.) *Fish*

**209. Problems in State Government and Politics.** One course. (3 graduate units.) *Leach*

**210. The Politics of Education.** The forces in local, state, and national politics which impinge on educational policymaking and administration. Not open to students who have had Political Science 313. (Also listed as Education 210.) One course. (3 graduate units.) *Leach*

**211. Contemporary Japanese Politics.** Postwar Japan with emphasis on the rapidly changing political culture, bureaucratic politics, the issue of imported democratic institutions, and the emergence of citizenship. One course. (3 graduate units.) *McKean*

**212. Japanese Foreign Policy.** The transition from militarism to pacifism in Japan's international posture, emphasis on the postwar American alliance, the questions of rearmament and nuclear weapons, and the domestic constraints on foreign policymaking. One course. (3 graduate units.) *McKean*

**214. Comparative Administrative Law.** Comparative analysis of the role of administrative techniques in established and transitional constitutional systems. French, German, British, and American patterns. Control of legality and expediency of various types of judicial review. One course. (3 graduate units.) *Grzybowski*

**215. Comparative Legislative Processes.** Analysis of the structures and functions of legislative institutions and of the behavior of legislative elites in both parliamentary and congressional systems. One course. (3 graduate units.) *Mishler*

**216S. Comparative Politics of the Welfare State.** Analysis of the political processes that shape very different solutions to similar social problems in advanced industrial nations. Examination of the development of income-maintenance programs and health care systems, with some discussion of other social policies. (Also listed as Public Policy Science 216S.) One course. (3 graduate units.) *Stone*

**217S. Economic Theories of Political Behavior.** Analysis of economic theories and other formal techniques applied to problems of voting behavior, legitimacy and constitutional choice, and to strategies of political conflict and coalition. One course. (3 graduate units.) *Rogowski*

**218S, 219S. Political Thought in the United States.** Writings of leading political theorists. First semester: founding fathers and their European and Puritan antecedents; the abolitionists and Calhoun. Second semester: Progressive period and recurrent themes of contemporary protest and debate. (Offered in alternate years.) Two courses. (6 graduate units.) *Price*

**220S. Problems in International Politics.** Prerequisites: one course on international relations, foreign policy, or diplomatic history. One course. (3 graduate units.) *Holsti*

**221. International Organization.** The functioning of the United Nations sys-

tem and of regional organizations operating in the political and security fields. One course. (3 graduate units.) *Staff*

**222. Empirical Theory.** Critical examination of contemporary, non-normative conceptual frameworks for political inquiry, with emphasis on the qualifications of these frameworks as theories. One course. (3 graduate units.) *Trilling*

**223. Political Philosophy from Plato to Machiavelli.** Intensive analysis of the political philosophies of Plato and Aristotle, a survey of medieval political thought and an analysis of the significance of Machiavelli. One course. (3 graduate units.) *Hallowell*

**224. Modern Political Theory.** An historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. One course. (3 graduate units.) *Hallowell*

**225. Comparative Government and Politics: Western Europe.** Rise of modern political parties; extension of the suffrage; entry of bourgeoisie, peasants, and workers into politics; center-periphery conflicts; emergence of the welfare state and of planned economies; problems of "collectivist" politics. One course. (3 graduate units.) *Rogowski*

**226. Theories of International Relations.** Contemporary theories of international relations and foreign policy. Emphasis on the interdependence of theory and empirical research. One course. (3 graduate units.) *Eldridge*

**227. International Law.** Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. One course. (3 graduate units.) *Grzybowski*

**228. Soviet Public International Law.** Institutions and doctrines of the international law of peace as interpreted and applied by the Soviet government. Basic concepts including the theory of socialist international law and principle of peaceful coexistence. One course. (3 graduate units.) *Grzybowski*

**229. Recent and Contemporary Political Theory.** The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, nationalism, fascism and national socialism, the crisis in modern democracy, Christianity and the social order. (Not open to students who have taken Political Science 132.) One course. (3 graduate units.) *Hallowell*

**230. American National Government.** Formation and contemporary operation of the national political system; historical and behavioral approaches. One course. (3 graduate units.) *Staff*

**231. American Political Theory.** An analysis of the main currents in American political thought from colonial beginnings to the present day, with emphasis upon the development of liberalism in America. One course. (3 graduate units.) *Staff*

**233. Research Methodology.** Measurement, causal analysis, and comparison of different levels of analysis, and other problems in political research. One course. (3 graduate units.) *Trilling*

**235. The Commonwealth.** Analysis of political relationships among the members of the Commonwealth countries, with emphasis on Canada. One course. (3 graduate units.) *Staff*

**236. Statistical Analysis.** Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. One course. Not open to students who have had or are enrolled in Political Science 138, Psychology 117, Mathematics 53 or 183, Management Sciences 110, or Economics 138. (3 graduate units.) *Trilling*

**237S. Problems in American Foreign Policy.** The decision-making process as applied to contemporary foreign policy issues. Prerequisite: Political Science 122 or the equivalent. One course. (3 graduate units.) *Staff*

**238. Comparative Foreign Policy.** An application of comparative theory to the foreign policy decision-making processes of major, middle range, and developing states. One course. (3 graduate units.) *Eldridge*

**239S. Current Problems of International Law.** Theoretical trends, use of sources for research, role of international law in diplomacy and legal practice. For seniors and graduates only. One course. (3 graduate units.) *Grzybowski*

**241. Public Administrative Organization and Management.** The American administrative process: theory and practice of administrative organization and management. One course. (3 graduate units.) *Hall*

**243. Applications of Administrative and Organizational Theory.** Behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Also listed as Public Policy Science 224.) One course. (3 graduate units.) *Hawley*

**244. Administrative Law and Process.** The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. One course. (3 graduate units.) *Hall*

**245S. Ethics and Policymaking.** (Also listed as Public Policy Science 223S.) One course. (3 graduate units.) *Price*

**246. Administrative and Public Policy.** The role of administration in the American policy process. One course. (3 graduate units.) *Hall*

**247. Political Participation and Policy Outcomes.** Impact of citizen participation upon governmental decision-making. Theoretical issues and empirical evidence (primarily American, but partly comparative). (Also listed as Public Policy Science 247.) One course. *Hough*

**248. The Politics of the Policy Process.** (Also listed as Public Policy Science 219.) One course. (3 graduate units.) *Behn and Salamon*

**249. Comparative Political Analysis and Political Development.** General methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theory of political development. Theoretical problems of induced political change. One course. (3 graduate units.) *Braibanti*

**250. Comparative Government and Politics: Southern Asia.** The political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitu-



tional, and institutional aspects of the political systems. Impact of foreign technical assistance. One course. (3 graduate units.) *Braibanti*

**252. Comparative Political Behavior and Socialization.** Elites and mass publics in a variety of Western and non-Western societies including the United States; models of the political socialization process and their implications for democratic theory. One course. (3 graduate units.) *Mishler*

**253. Comparative Politics and the Study of Latin America.** Current literature on major themes of Latin American politics. One course. (3 graduate units.) *Valenzuela*

**257S, 258S. Modern East Asia.** Introduction to Problems and Literature. (Also listed as History 257S, 258S and as Interdisciplinary Course 257S, 258S.) Two courses. (6 graduate units.) *Dirlik, McKean, and Stone*

**260. The Tradition of Political Inquiry.** Past and present problems, goals, presuppositions, and methods. One course. (3 graduate units.) *Spragens*

**271. Political Processes in Traditional and Modern Africa.** Patterns of change in selected African societies from the pre-colonial to the post-colonial period, emphasizing the interaction between traditional, colonial, and post-colonial institutions and their impact upon African societies. One course. (3 graduate units.) *Johns*

**273. The American South as a "Developing Society."** The concept of modernization as a tool of social and political analysis, and its applicability in explaining the patterns of political and economic evolution in the American South. One course. (3 graduate units.) *Salamon*

**274. Political Psychology.** Psychological aspects of political performance by citizens, activists, and leaders. One course. (3 graduate units.) *Barber*

**275. The American Party System.** An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, recent foreign policy and party alignments, and the controversy over party government. One course. (3 graduate units.) *Kornberg*

**277. Comparative Party Politics.** The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. Emphasis upon research techniques and objectives. One course. (3 graduate units.) *Kornberg*

**278. Canadian Political Behavior in the North American Context.** Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. One course. (3 graduate units.) *Kornberg*

**279. The Legislative Process.** An analysis of the structure and functions of Congress with emphasis on the behavior of legislators and resultant public policy. Some considerations will be given to American state and foreign legislatures. One course. (3 graduate units.) *Paletz*

**280. Comparative Government and Politics: Sub-Saharan Africa.** Politics and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. One course. (3 graduate units.) *Johns*

**283S. Congressional Policymaking.** Lawmaking and oversight of the bureaucracy by the United States Congress. Committee roles, impact of the

executive and other external forces. (Also listed as Public Policy Science 283S.) One course. (3 graduate units.) *Price*

**285. The Judicial Process.** A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisite: Political Science 127 or 207 or the equivalent. One course. (3 graduate units.) *Fish*

**291. Problems of Urban Government.** One course. (3 graduate units.) *Leach*

**293. Federalism.** Theoretical and operational aspects of federal systems of government, focusing on the United States and Canada. One course. (3 graduate units.) *Leach*

### For Graduates

**301. Teaching Political Science.** Examination of art and craft of teaching political science including philosophy and purposes of education, nature and function of universities, students, teaching content, and course structures and methodologies. 3 units. *Paletz*

**303. Seminar on Selected Topics in Statistics.** Introduction to the assumptions and uses of selected multivariate statistics and research methodologies including least-squares analysis, scaling techniques, factor analysis, causal inference, model-building, and computer simulation. Prerequisite: Political Science 236 or consent of the instructor. 3 units. *Mishler*

**306. Seminar in Politics and the Mass Media of Communication.** Prerequisite: Political Science 206 or consent of the instructor. 3 units. *Paletz*

**307. Graduate Seminar in American Voting Behavior.** Focus on contemporary and original research in American voting behavior. 3 units. *Trilling*

**308. Individual Research in Political Science.** The student will conduct research designed to evaluate an hypothesis of his choice. A report on the research must be presented in adequate professional style. 3 units. *Staff*

**309. Seminar in International Relations.** Critical survey of theories and research in international relations and foreign policy. Emphasis will be placed on the interrelation between theory and research. 3 units. *Holsti*

**310. Seminar in State and Local Government.** (Offered in alternate years.) Prerequisites: Political Science 209 and 291 or their equivalents. 3 units. *Leach*

**312. Seminar in Constitutional Law.** Prerequisite: Political Science 207 or the equivalent. 3 units. *Fish*

**313. Education and Public Policy.** (Also listed as Education 313.) Not open to students who have had Political Science 210. 3 units. *Leach and Pittillo*

**321. Seminar in Political Theory.** (Offered in alternate years.) Prerequisites: 6 units in Political Science 223, 224, 229, 231 or equivalents. 3 units. *Hallowell*

**322. Seminar in Selected Topics in Empirical and Formal Theory.** The empirical and formal treatment of concepts such as power, support, rationality and collective choice. Prerequisite: Political Science 222 or 233, or consent of instructor. 3 units. *Trilling*

**323. Seminar in Modern Political Theory.** Prerequisite: two 200-level courses in Political Theory or consent of instructor. 3 units. *Spragens*

**325. Seminar in Comparative Government and Politics.** 3 units. *Rogowski*

**329. Seminar in International Regional Organization.** (Offered in alternate years.) Prerequisite: Political Science 221 or the equivalent. 3 units.

**330. Seminar in Comparative Government and Politics—Southern Asia.** Emphasis on research using documentary materials relating to India, Pakistan, Ceylon, and Malaysia. Prerequisites: Political Science 250, 251, or equivalents. Offered in alternate years. *Braibanti*

**331. Seminar in American Political Thought.** 3 units. *Leach*

**340. Seminar in American Politics and Institutions.** Survey, analysis, and critique of the literature. 3 units. *Paletz*

**341. Seminar in Public Administration.** Selected topics in administrative and organizational theory and behavior. Prerequisite: Political Science 141 or 243. 3 units.

**342. Seminar in American National Government and Politics.** Prerequisite: Political Science 230 or its equivalent. 3 units. *Barber*

**343. Seminar in the Policy Process.** Selected topics covering the theory, methodology, and practice of policy formation in American politics. Prerequisite: Political Science 246 or its equivalent. 3 units.

**344. Workshop on Computer Models of Social Systems.** (Also listed as Computer Science 344 and Economics 344.) 3 units. *Naylor*

**360. Seminar in Government and Politics in the Soviet Union.** Prerequisite: Political Science 165, or consent of instructor. 3 units. *Hough*

**361. Seminar in Foreign Relations of the Soviet Union.** Prerequisite: Political Science 220 or 360, or consent of instructor. 3 units. *Hough*

**376. Seminar in Comparative Political Behavior.** An intensive comparative examination of the impact of selected political institutions on political behavior. (Offered in alternate years.) 3 units. *Kornberg*

**380. Seminar in African Government and Politics.** Prerequisite: Political Science 280 or its equivalent. (Offered in alternate years.) 3 units. *Johns*

**381. Research Seminar in Latin American Government and Politics.** Prerequisite: Political Science 253 or the equivalent. (Offered in alternate years.) 3 units. *Valenzuela*

**382. Soviet Law and Society.** 2 units. *Grzybowski*

**401. Seminar in the Commonwealth.** 3 units. *Members of the Committee on Commonwealth Studies*

**402. Interdisciplinary Seminar in the History of the Social Sciences.** A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

### **Related Course Work in the School of Law**

There may be graduate credit for course work completed in the Duke University School of Law, under regulations referred to in this *Bulletin* under Academic Regulations.

## **Psychology**

Professor Alexander, *Chairman* (244 Psychology-Sociology Building); Professor Staddon, *Director of Graduate Studies* (242 Psychology-Sociology Building);

Professors Bevan, Borstelmann, Carson, Diamond, R. Erickson, Guttman, Jones, Lakin, Lockhead, Schiffman, M. Wallach, and Wing; Associate Professors Coie, Costanzo, C. Erickson, Hall, and McConahay; Assistant Professors Aderman, Eckerman, Fischer, Kalat, Kremen, Levy, Norton, Robinson, Roth, and White; Lecturers Casseday, Crovitz, Gentry, Marsh, Oppenheim, Peele, Shows, Somjen, L. Wallach, and Wolbarsht; Visiting Scholars Zvi Giora, and Janice Moulton

The department offers work leading to the Ph.D. degree. The areas of concentration are experimental, biological, cognitive, social, personality, developmental, and clinical psychology. Students in experimental, biological, and cognitive psychology should have a strong undergraduate background in basic science: mathematics, physics, biology, and chemistry.

A brochure is available from the Director of Graduate Studies which describes the program in more detail and gives information on financial assistance, facilities, and current research activity.

### For Seniors and Graduates

**203. Sensation and Perception.** An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. One course. (3 graduate units.) *Lockhead*

**206. Comparative Psychology.** Eminent comparative psychologists and their work. One course. (3 graduate units.) *Kalat*

**210. Cognitive Psychology.** Theoretical approach; stresses interconnections across perception, memory, thinking, language, and use of models. One course. (3 graduate units.) *Robinson*

**212. Human Memory.** Literature, classical and modern; data and theories relating to mechanisms of information processing, storage, and retrieval. One course. (3 graduate units.) *Bevan*

**213. Adaptive Behavior.** The principles of adaptive behavior in animals, with special emphasis on the effects of reward and punishment. Prerequisite: consent of instructor. One course. (3 graduate units.) *Staddon*

**214, 215. Developmental Psychology.** Current research and theory. First semester: comparative and biological approaches to human development. Infancy and social development. Second semester: cognitive development. Two courses. (6 graduate units.) *Eckerman, L. Wallach, and Staff*

**216. Biological Psychology.** The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include: the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include: ablation method, method of evoked potential, electrical stimulation of the brain, and classical and physiological genetics. One course. (3 graduate units.) *Diamond*

**217. Social Psychology.** Social factors in cognition, models of social interaction, conformity, and social influence, and attitude development and change. One course. (3 graduate units.) *Jones*

**218. Research Methods in Social Psychology.** Emphasis on the interplay between experimental design and technique. One course. (3 graduate units.) *Aderman*



**219. Neural Bases of Behavior.** Structure and function of the nervous system as related to problems of sensory-motor processes, learning, and memory. One course. (3 graduate units.) *R. Erickson*

**228. Visually Guided Behavior.** Anatomical and physiological maturation of the nervous structures mediating visual behaviors. How the maturation of the visual pathway may contribute to the development of these behaviors. One course. (3 graduate units.) *Norton*

**230. Social Behavior of Animals.** Developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive behavior. One course. (3 graduate units.) *C. Erickson*

**234. Seminar in Personality.** Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. One course. (3 graduate units.) *M. Wallach*

**238. Electroencephalogram and Psychological Function.** A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, reaction time, and attention. Emphasis on the electrophysiology of conditioning and learning. Lectures, laboratory demonstrations, and clinical case presentations. One course. (3 graduate units.) *Marsh*

**245. Personality Theory I.** Representative theories of human functioning, from Freud to neoanalytic approaches. One course. (3 graduate units.) *Alexander, Kremen or Schiffman*

**246. Personality Theory II.** Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. One course. (3 graduate units.) *Alexander, Kremen or Schiffman*

**253. Psychological Approaches to Public Policy Analysis.** (Also listed as Public Policy Science 253.) One course. (3 graduate units.) *McConahay*

**261. Science, Politics, and Government.** The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Science 255 and Sociology 261.) One course. (3 graduate units.) *Bevan or McKinney*

**271S. Selected Problems.** One course. (3 graduate units.) *Staff*

**273-274. Statistical Principles in Experimental Design.** The problems of scientific inference; methods of data analysis and issues in experimental design. Two courses. (6 graduate units.) *Roth*

**276. Neuroanatomical Basis of Sensory Physiology.** Original papers are read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. (Also listed as Anatomy 276.) One course. (3 graduate units.) *Hall*

**280. Psychology as a Science.** Epistemology of psychology in its historical evolution from Mach, Newton, and Kant through Darwin, Freud, and Hull; emphasis on practice in current areas of science; roles of research techniques and language, construct usage, hypotheses, and general processes of developing understanding in various current areas. One course. (3 graduate units.) *R. Erickson*

**282. Introduction to Methods of Psychotherapy.** Current trends in psycho-

therapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy.; consent of the instructor. One course. (3 graduate units.) *Carson or Martin Lakin*

**283, 284. The History of Psychology.** First semester: Aristotle to Kant; second semester: development of modern psychology. Prerequisite for 284: Psychology 283 or consent of instructor. Two courses. (6 graduate units.) *Guttman*

**291. Seminar in Community Mental Health.** Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public-health approach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning. One course. (3 graduate units.) *Staff*

**293. Methods in Developmental Psychology.** Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. One course. (3 graduate units.) *Staff*

### For Graduates

**305. Psychopathology.** An examination of behavior disorders, with particular emphasis on explanatory concepts and the evidence from research in this field. 3 units. *Staff*

**306. Seminar in Developmental Psychology.** Selected topics in cognitive, emotional, and social development. 3 units. *Staff*

**309. Seminar in Learning.** Selected topics in operant conditioning and discrimination learning. 3 units. *Staddon*

**310. Seminar in Perception.** 3 units. *Lockhead*

**313. Seminar on the Concept of the Reflex.** A consideration of the reflexological principles found in the works of Sherrington, Sechenov, Pavlov, Eccles, Skinner, Konorski, *et al.*, and an examination of the critiques of Goldstein, Lashley, and others. 3 units. *Diamond and Guttman*

**314. Seminar in Instrumental Behavior.** 3 units. *Staff*

**316. Seminar in Social Psychology.** 3 units. *Jones*

**317. Seminar in Social Behavior.** 3 units. *Staff*

**318. Seminar in Social Influence.** 3 units. *Brehm*

**319-320. Research-Clinical Tutorial.** 6 units. *Staff*

**321. Seminar in Psychophysiology of Hearing.** An examination of the relation of anatomy and physiology to psychophysics of the auditory system. Prerequisite: consent of the instructor. 3 units. *Casseday*

**325. Seminar in Animal Behavior.** Selected topics in the reproductive behavior of animals. 3 units. *C. Erickson*

**327, 328. Foundations of Clinical Psychology.** A review in depth of selected issues, concepts, and empirical findings of general psychology that have immediate or potential relevance to the theory and practice of clinical psychology. The several subdisciplines such as social, developmental, and biological psychology will be scanned so as to identify content areas that intersect with or have implications for the concerns of clinical-personality psychology. 3 units per semester. *Carson or Staff*

**329-330. Pro-Seminar in Psychology.** An intensive examination of original

sources in experimental and biological psychology. Ordinarily taken by all students in the natural-science division in their first year of residence. 6 units. *Staff*

**333, 334. Seminar: Behavioral Studies of the Brain.** Selected topics in the neural bases of behavior. 3 units per semester. *R. Erickson and Norton*

**335-336. Clinical Inquiry I.** This course focuses on the process of understanding intra- and inter-person systems, largely in a practicum context. 6 units. *Staff*

**337. Seminar in Sensory Discrimination.** The neural bases of discrimination in vertebrates and invertebrates is studied by neurophysiological, electrophysiological, and psychophysical techniques. 3 units. *R. Erickson and Wolbarsht*

**340. Group Processes and Sensitivity Training.** 3 units. *Lakin*

**343, 344. Clinical Inquiry II.** Intensive experience and supervision in techniques of psychotherapy and behavior modification. 3 units per semester. *Staff*

**347-348. Personality Assessment.** Introduction to the assessment of human personality through the study of personal documents, interview data, objective and projective test material. Laboratory sessions will be concerned with personality assessment of normal human subjects over extended time periods. 6 units. *Alexander or Kremen*

**350. Practicum in Psychological Research.** Ordinarily taken by all students in the natural-science division in their first semester of residence. 3 units. *Staff*

**393. Integrative and Clinical Neurophysiology.** (Also listed as Physiology 393.) 3 units. *Somjen or Staff*

## Public Policy Sciences

Professor Fleishman, *Director*; Associate Professor Hawley, *Associate Director, Director of Graduate Studies*; Professor Estes (Medicine), Hough (Political Science), and Long (Law); Associate Professors Behn, Blaydon, Danjani, Grabowski, McConahay, and Price; Assistant Professors Decker, Fischer, Goodwyn, Lipscomb, Salamon, and Stack; Lecturers Kuniholm, Payne, Stone, and Vaupel

The graduate program in public policy sciences is offered through the Institute of Policy Sciences and Public Affairs. The course of study consists of a series of joint degree programs leading to the degrees of Master of Arts in public policy sciences, and a doctoral or professional degree. Such a program is designed to foster in highly trained professionals the perceptual and analytical skills necessary for sound public decision-making. The Institute does not award independent A.M. or Ph.D. degrees.

With the exception of those individuals already possessing doctoral or professional degrees, therefore, all graduate students in the Institute must pursue a concurrent degree in another department or school at Duke, or at a nearby cooperating institution. Joint degree programs exist or are being developed between the Institute and the Schools of Law, Engineering, Medicine, and Business Administration, and with several graduate departments.

Students usually apply for the joint degree program simultaneously with their applications to the graduate departments or professional schools, or during their first or second year of advanced study. Candidates are expected to complete an equivalent of one full year of work beyond that which their doctoral or professional degree would require alone.

The joint degree curriculum involves a minimum of ten courses, to be specified by the Institute. Academic work includes a four-course research sequence and a summer internship in such specialized policy areas as law and the administration of justice, communications, health, and education. This policy-research sequence, in which the student works closely with faculty in tutorial or small group situations, stresses the development of analytical skills applicable to the broad range of policy arenas.

Further information concerning specific joint degree programs may be obtained from the Director of Graduate Studies (109 Old Chemistry.)

### For Seniors and Graduates

**204S. Ethics in Political Life.** (Also listed as Political Science 204.) One course. (3 graduate units.) *Spragens*

**216S. Comparative Politics of the Welfare State.** (Also listed as Political Science 216S.) One course. (3 graduate units.) *Stone*

**217. Microeconomics and Public Policymaking.** Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision-making. One course. (3 graduate units.) *Cook, Lipscomb, or Behn*

**219. The Politics of the Policy Process.** A formulation of public policy-making, substantive policies in a variety of contexts from local government to international affairs; the role of legislatures, interest groups, executive branches, and the bureaucracy in defining alternatives and in shaping policy from agenda formulation to implementation. (Also listed as Political Science 248.) One course. (3 graduate units.) *Behn or Salamon*

**221. Analytical Methods I: Decision Analysis for Public Policy Makers.** Methods for structuring decision dilemmas and decomposing complex problems, assessing the probabilities of uncertain consequences of alternative decisions, appraising the decision maker's preferences for these consequences and for reexamining the decision. (Not open to students who have taken Public Policy Studies 55.) One course. (3 graduate units.) *Blaydon, Fischer, or Behn*

**222. Analytical Methods II: Data Analysis for Public Policy Makers.** Sampling theory, Bayesian statistics, and regression analysis. Examples from problems in health care, transportation, crime, urban affairs, and politics. (Not open to students who have taken Public Policy Studies 112.) One course. (3 graduate units.) *Behn, Fischer, or Vaupel*

**223S. Ethics and Policymaking.** Normative concepts in politics—liberty, justice, the public interest: historical and philosophical roots; relationship to one another and to American political tradition; and implications for domestic policy problems. (Listed also as Political Science 245.) One course. (3 graduate units.) *Price*

**224. Applications of Administrative and Organizational Theory.** (Also listed as Political Science 243.) One course. (3 graduate units.) *Hawley*

**231. Analytical Methods III: Evaluation of Public Programs and Policies.** Theoretical treatment of cost-benefit analysis; discussion of several prospective and retrospective evaluations of public programs and policies. Examples from law enforcement, health, income maintenance and other policy areas. Prerequisites: Public Policy Studies 55 or Public Policy Sciences 221, 112 or 222, and 110 or 217, or Economics 149. One course. (3 graduate units.) *Cook and Fischer*



**232. Analytical Methods IV: Regression and Simulation Techniques for Policy Analysis.** The theory and policy-oriented applications of regression analysis and simulation techniques. Includes an introduction to the use of several standard computer programs. One course. (3 graduate units.) *Cook and Vaupel*

**233. Analytic Approaches to Bargaining, Cooperation, and Competition.** Application of principles of game theory, economics, and psychology to labor-management negotiation, plea bargaining, public interest group formation, corporate collusion, business mergers, and arms limitations. One course. (3 graduate units.) *Blaydon and Fischer*

**246. Population Policy.** (Also listed as Sociology 246.) One course. (3 graduate units.) *Back*

**247. Political Participation and Policy Outcomes.** (Also listed as Political Science 247.) One course. (3 graduate units.) *Hough*

**252S. National Security Policy.** Application of decision analysis and normative and organizational theory and historical systems, to major strategic decisions, and selected foreign policy issues. One course. (3 graduate units.) *Fischer and Kuniholm*

**253. Psychological Approaches to Public Policy.** Contribution of psychological analysis to an understanding of social issues such as poverty, drug abuse, crime, crowding, and race relations, the ways problems are recognized, and why different policy alternatives are selected, (e.g., those that "blame the victim,"). (Also listed as Psychology 253.) One course. (3 graduate units.) *McConahay*

**254. Transportation Planning and Policy Analysis.** (Also listed as Civil Engineering 216.) Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. One course. (3 graduate units.) *Behn or Dajani*

**255. Science, Politics, and Government.** An examination of the structure and values of the scientific community; the mechanisms and strategies of government; and their mutual interdependence in American society. (Also listed as Psychology 255 and Sociology 261.) One course. (3 graduate units.) *Bevan and McKinney*

**256. The Economics of Health Care.** One course. (3 graduate units.) *Lipscomb*

**260S. Public Policy Research Seminar: The Administration of Justice.** One course. (3 graduate units.) *Staff*

**261S. Research Seminar: Health Policy.** Determinants and impacts of public policies designed to improve the equity and efficiency of health services. The supply and distribution of services; the cost of services and alternative modes of financing; the quality of services and alternative mechanisms of quality control. Applied research paper. One course. (3 graduate units.) *Lipscomb and Stone*

**262S. Research Seminar: Communications I.** One course. (3 graduate units.) *Staff*

**263S. Public Policy Research Seminar: Urban and Regional Development Policy.** Dynamics of urban and regional development analyzing alternative policy instruments for coping with the social, environmental, and economic effects. Housing, land use, transportation, taxation, environmental protection, and related urban development problems and policies. Prerequisite: Political Science 176, Political Science 109, Economics 234 or consent of instructor. One course. (3 graduate units.) *Salamon*

**264S. Public Policy Research Seminar: Topics in Public Policy I.** Selected topics. One course. (3 graduate units.) *Staff*

**270S. Humanistic Perspectives on Public Policy.** Modes of inquiry into aspects of social life important to policy makers but beyond the normal reach of social science. Reading from James Agee, Robert Coles, Eudora Welty, James Baldwin, George Eliot, and others. Prerequisite: consent of instructor. One course. (3 graduate units.) *Payne and Coles*

**271. The Uses of History in Public Policy-Making I.** Introduction to historical analysis as a technique for formulating and evaluating public policy. (Also listed as History 203.) One course. (3 graduate units.) *Staff*

**272. Poverty in Non-Urban America: An Historical Perspective on the Inadequacy of Public Policy.** An historically based exploration of the social, political, and cultural sources; contemporary policy alternatives. One course. (3 graduate units.) *Decker*

**273. The Uses of History in Public Policy II.** Introduction to historical analysis as a technique for formulating and evaluating public policy. Emphasis on public policy decisions abroad since World War II, including the structuring of selected contemporary problems in light of their historical contexts. One course. (3 graduate units.) *Kuniholm*

**275. Class, Ethnicity and Social Policy.** The uses of anthropological modes of analysis for understanding social issues and public policy with a focus on class, work, ethnicity, sex roles, and the family. (Also listed as Anthropology 277.) One course. (3 graduate units.) *Stack*

**283. Congressional Policy-Making.** (Also listed as Political Science 283S.) One course. (3 graduate units.) *Price*

## For Graduates

**391. Multinational Corporations Seminar.** The nature and consequences of multinational corporations. The international economic environment in which multinational corporations operate. The problems of managing a multinational corporation. Public policy toward multinational corporations. (Also listed as Business Administration 391.2.) 3 units. *Vaupel*

**340-390. Public Policy Research Seminars.** Students pursuing a Master of Arts degree in public policy sciences are expected to take a series of three or four sequential courses which examines issues in specialized public policy areas, such as: law and the administration of justice, communications, health, urban and regional land use, and education. The series begins with a 260 level course, continues with courses from this series, and includes a thesis seminar and an optional summer internship. 12 units. *Staff*

## Religion

Professor Poteat, *Chairman*; Professor M. Smith, *Director of Graduate Studies* (209A Divinity School); Professors Baker, Beach, Bradley, Cushman, Davies, Henry, Herzog, Lacy, Langford, Long, Murphy, Osborn, Price, H. Smith, and Young; Associate Professors Bailey, Charlesworth, Kort, Lawrence, Meyers, Partin, Raitt, Robinson, Steinmetz, and Wintermute; Assistant Professor Corless

The Department of Religion offers graduate work leading to the A.M. and Ph.D. degrees. Students may major in one of three fields: (1) Biblical studies; (2) historical studies; and (3) systematic and contemporary studies. They will

be expected to take such courses in one or both of the other fields which will contribute to an adequate understanding of their chosen fields of specialization.

In addition to course work in these major fields, students will take such other courses in cognate fields as will contribute to the enrichment of their major studies. This minor requirement may be fulfilled either by work in a cognate department, such as classical studies, history, political science, or sociology, or by work in a cognate field within the Department of Religion other than the field of major concentration.

The program of doctoral studies presumes a foundation in the academic study of religion. Students applying for graduate work in religion directly from an undergraduate program should have had a strong undergraduate major in religion, and will be accepted for the Ph.D. program only upon the satisfactory completion of the A.M. degree with the department.

## FIELD I. BIBLICAL STUDIES

**207. Second Hebrew.** Historical Hebrew grammar with reading and exegesis of Old Testament prose: Pentateuch and historical books in alternate years. First semester. One course. (3 graduate units.) *Wintermute*

**208. Second Hebrew.** Historical Hebrew grammar and rapid reading of prose and poetry. Second semester. One course. (3 graduate units.) *Murphy*

**209. Old Testament Theology.** Studies of the Old Testament in regard to theological themes and content. 3 units. *Murphy*

**220. Third Hebrew.** An interpretive study of late Hebrew prose, with readings from Chronicles, Ecclesiastes, and the Mishnah. One course. (3 graduate units.) *Davies or Myers*

**221. Readings in Hebrew Biblical Commentaries.** Selected Hebrew texts in Midrash Aggadah and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. One course. (3 graduate units.) *Bland*

**223A. Exegesis of the Hebrew Old Testament: Amos and Hosea.** Interpretation based upon Hebrew exegesis, stress upon hermeneutic methods. 3 units. *Bailey*

**223B. Exegesis of the Hebrew Old Testament: Job.** 3 units. *Murphy*

**223C. Exegesis of the Hebrew Old Testament: Exodus.** 3 units. *Bailey*

**223D. Exegesis of the Hebrew Old Testament: Song of Songs.** 3 units. *Murphy*

**225. Living Issues in New Testament Theology.** Critical examination of major problems and issues in New Testament interpretation and theology. 3 units. *M. Smith*

**226A. Exegesis of the Greek New Testament I (Mark and Matthew).** 3 units. *Price or Smith*

**226B. Exegesis of the Greek New Testament I (Romans).** 3 units. *Price*

**226D. Exegesis of the Greek New Testament I (I and II Corinthians).** 3 units. *M. Smith*

**226E. The Gospel and Epistles of John.** Exegesis of the Johannine literature in Greek. 3 units. *M. Smith*

**227A. Exegesis of the Greek New Testament II (Luke-Acts).** 3 units. *Young*

**227B. Exegesis of the Greek and New Testament II (Galatians).** 3 units. *Smith*

**227C. Exegesis of the Greek New Testament II (The Pastoral Epistles).** 3 units. *Young*

**228. The Theology of the Gospel and Epistles of John.** A study of the origin of these writings; the provenance of their thought forms and symbolism; their influence on the early church; and contemporary significance. One course. (3 graduate units.) *Price*

**237. History of the Ancient Near East.** Emphasis upon the religions, literature, and art of Mesopotamia. 3 units. *Bailey*

**239. Introduction to Middle Egyptian.** Grammar and readings in hieroglyphic texts relating to the Old Testament. One course. (3 graduate units.) *Wintermute*

**242. Life After Death in Semitic Thought.** Consideration of the various ideas from the early second millennium through the Intertestamental Period. Exegesis of selected Old Testament passages. Evaluation of recent research. Knowledge of Hebrew helpful but not required. 3 units. *Bailey*

**244. The Archeology of Palestine in Hellenistic-Roman Times.** The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. Prerequisite: reading knowledge of a Biblical language. One course. (3 graduate units.) *Meyers*

**258. Coptic.** Introduction to the Sahidic dialect with selected readings from Christian and Gnostic texts. Prerequisite: at least one year of Greek. One course. (3 graduate units.) *Wintermute*

**302. Studies in the Intertestamental Literature.** Selected documents of the Apocrypha and Pseudepigrapha examined exegetically and theologically in their relation to post-exilic Judaism. Prerequisite: consent of instructor. 3 units. *Charlesworth*

**304. Aramaic.** A study of the Aramaic portions of the Old Testament and selected passages from the Targums, Midrashes, and Talmuds. 3 units. *Meyers or Murphy*

**304A. Targumic Aramaic.** An introduction to the language and literature of the Aramaic translations of the Old Testament. 3 units. *Meyers*

**306. Language and Literature of the Dead Sea Scrolls.** A study in interpretation. Prerequisite: a knowledge of Hebrew. 3 units. *Charlesworth*

**307. Syriac.** A study of the script and grammar, with readings from the Syriac New Testament and other early Christian documents. Prerequisite: some knowledge of Hebrew and Aramaic. 3 units. *Charlesworth*

**311. Pharisaic Judaism in the First Century.** A reading course in first-century Pharisaic Judaism. 3 units. *Davies*

**312. Pauline Theology.** Studies in aspects of Paulinism in the light of recent scholarship. 3 units. *Davies*

**314. Judaism and Christianity in the New Testament.** Their interaction. 3 units. *Davies*

**319. The Gospel According to St. Matthew in Recent Research.** 3 units. *Davies*

**323A. Comparative Semitic I.** An introduction to the morphology and syntax of classical Arabic and the Semitic languages of Mesopotamia, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*



**323B. Comparative Semitic II.** An introduction to the morphology and syntax of classical Ethiopic and the Semitic languages of Palestine-Syria, together with a consideration of their relationship to Hebrew. 3 units. *Wintermute*

**340-341. Seminar in the New Testament.** Research and discussion on a selected problem in the Biblical field. 3 units per semester. *Price, Smith, and Young*

**345. The Epistle to the Hebrews in Recent Research.** Intensive attention to the text and to secondary sources. 3 units. *Davies*

**350-351. Old Testament Seminar.** Research and discussion on selected problems in the Old Testament and related fields. 3 units per semester. *Murphy*

**353. Seminar on Text Criticism.** Emphasis upon transmission, versions, apparatus, and method. Prerequisite: reading knowledge of Hebrew and Greek. 3 units. *Bailey*

**373-374. Elementary Akkadian.** Study of the elements of Akkadian grammar. Reading of neo-Assyrian texts shedding light on the Old Testament. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

**375-376. Elementary Ugaritic.** Study of the elements of Ugaritic. Prerequisite: Biblical Hebrew. 6 units. *Bailey*

**401. Colloquium in Biblical Studies.** A colloquium in which all graduate faculty and students in the Biblical division participate. Research papers in the Biblical field are read and discussed.

## FIELD II. HISTORICAL STUDIES

**206. Christian Mysticism in the Middle Ages.** Source studies in historical perspectives of such late medieval mystics as Bernard of Clairvaux, the Victorines, Ramon Lull, Meister Eckhart, Richard Rolle, Catherine of Siena, and Nicholas of Cusa. 3 units. *Raitt*

**217. Islam in India.** History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. One course. (3 graduate units.) *Lawrence*

**218. Religion in Japan.** A survey of religion in Japan, with special emphasis on indigenisation and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. One course. (3 graduate units.) *Corless*

**219. Augustine.** The religion of the Bishop of Hippo in the late antiquity. 3 units. *Gregg*

**236. Luther and the Reformation in Germany.** The theology of Martin Luther in the context of competing visions of reform. 3 units. *Steinmetz*

**238. Jewish Responses to Christianity.** Apologetic and polemical themes in rabbinic, medieval, and contemporary writings. One course. (3 graduate units.) *Bland*

**241. Problems in Reformation Theology.** 3 units. *Steinmetz*

**246. Problems in Historical Theology.** Prerequisite: consent of instructor. 3 units. *Raitt*

**247. Readings in Latin Theological Literature.** Critical translation and

study of important theological texts in Latin from various periods of the history of the Church. 3 units. *Steinmetz or Raitt*

**251. The Counter-Reformation and the Development of Catholic Dogma.** Issues in Roman Catholic theology from the Reformation to the Second Vatican Council. 3 units. *Raitt*

**260. Seminar: Wesley Studies.** The lives and thoughts of John and Charles Wesley and their colleagues in relation to English culture and religion in the eighteenth century. 3 units. *Baker*

**280. The History of Religions.** A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. One course. (3 graduate units.) *Partin*

**282. Myth and Ritual.** Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions, with particular attention to religious pilgrimage. One course. (3 graduate units.) *Partin*

**284. The Religion and History of Islam.** Origins and development of the Islamic community and tradition, with particular attention to the religious element. One course. (3 graduate units.) *Partin*

**285. The Vedic Tradition: Compilation and Interpretation.** Indian canonical writings, with emphasis on the literary stages and relation of the writings to later philosophical and religious movements. One course. (3 graduate units.) *Lawrence*

**287. The Scriptures of Asia.** Translations of basic texts from the religious traditions of India, China, and Japan. One course. (3 graduate units.) *Bradley*

**288. Buddhist Thought and Practice.** A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. One course. (3 graduate units.) *Corless*

**289. World Religions and Social Change.** The contemporary role of Buddhism, Christianity, and Islam in Asia and Africa. One course. (3 graduate units.) *Bradley*

**296. Religion on the American Frontier.** A study of the spread of evangelical Christianity as a theological and cultural phenomenon of the American West. 3 units. *Henry*

**308. Greek Patristic Texts.** Critical translation and study of selected Greek texts illustrative of significant aspects of patristic theology and history from the second through the fifth century A.D. 3 units. *Young*

**313. The Apostolic Fathers.** A study of the religious thought in the writings of the Apostolic Fathers. 3 units. *Young*

**315-316. Seminar: History of Religions.** Selected problems in the field. 3 units.

**317. Seminar in the Greek Apologists.** A study of the apologetic writings of the Greek Fathers in relation to the challenges of their contemporary world. Special attention will be given to leading protagonists of late Graeco-Roman culture, such as Celsus, Porphyry, and Julian. 3 units. *Young*

**318. Seminar in the Greek Fathers.** A study of selected topics from the Greek Fathers. 3 units. *Young*

**324. Readings in the History of Religion.** An examination of the theories, methods, and purposes of the study of non-Western religions within the Western tradition. 3 units. *Long*

**334. Theology and Reform in the Later Middle Ages.** The life and thought of the medieval Church from the 12th century through the 15th. Popular and academic theologians from Pierre Abelard to Gabriel Biel. 3 units. *Steinmetz*

**335. The English Church in the Eighteenth Century.** Studies of Christianity in England from the Act of Toleration, 1689, to the death of John Wesley, 1791. 3 units. *Baker*

**338. Calvin and the Reformation in Switzerland.** The theological development of John Calvin. A comprehensive examination of his mature position with constant reference to the theology of other reformers. 3 units. *Steinmetz*

**339. The Radical Reformation.** Protestant movements of dissent in the sixteenth century. Special attention will be devoted to Müntzer, Carlstadt, Hubmaier, Schwenckfeld, Denck, Marpeck, Socinus, and Menno Simons. 3 units. *Steinmetz*

**344. Zwingli and the Origins of Reformed Theology.** Source studies in the early Reformed tradition. 3 units. *Steinmetz*

**384. Religious Dissent in American Culture.** History and significance of dissent in the theology and culture of America. 3 units. *Henry*

**385. Religion in American Literature.** A critical study of the meaning and value of religious motifs reflected in American literature. 3 units. *Henry*

**391. Historical Types of Christian Ethics I.** A critical study of representative statements of Christian ethical theory, through the early Reformation. 3 units. *Beach*

**392. Historical Types of Christian Ethics II.** A continuation of Religion 391, from the Reformation through current Christian ethical theory. Prerequisite: Religion 391. 3 units. *Beach*

**395. Christian Thought in Colonial America.** Exposition of the main currents in Protestant theology. 3 units. *Henry*

**396. Liberal Traditions in American Theology.** A study of the main types of modern religious thought, beginning with the theology of the Enlightenment. 3 units. *Henry*

### FIELD III. SYSTEMATIC AND CONTEMPORARY STUDIES

**210. Contemporary British Theology.** A study of twentieth century British theology. Attention will be given to the Anglican, Free Church, and Scottish traditions. 3 units. *Langford*

**211. Authority in Theology.** The idea and function of authority in theology. 3 units. *Langford*

**212. Policy Making and Theological Ethics.** Relation of knowledge, power, and values in policy making; models of decision-making in the policy sciences and their ethical implications. 3 units. *McCollough*

**214. The Christian Doctrine of Salvation.** A systematic exposition and re-statement of the historic faith of the Church in relation to representative secular alternatives of ancient and modern times. 3 units. *Cushman*

**230. The Meaning of Religious Language.** An analysis of the credentials of some typical claims of theism in the light of theories of meaning in recent thought. (Also listed as Philosophy 230.) 3 units. *Potter*

**231. Seminar in Religion and Contemporary Thought.** Analytical reading

and discussion of such critical cultural analysis as is found in the works of M. Polanyi, Arendt, Trilling, and others, with appraisal of the relevance of theological inquiry. 3 units. *Poteat*

**232. Religion and Literature: Perspectives and Methods.** Selected literary works as interpreted by myth or archetype critics and by theological critics. One course. (3 graduate units.) *Kort*

**233. Modern Narrative and Religious Language.** Fiction of selected American, British, and continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. One course. (3 graduate units.) *Kort*

**245. Ethics in World Religions.** Moral foundations, assumptions and applications in such major faiths as Hinduism, Buddhism, Confucianism, and Islam, in the light of Christian ethical perspectives. 3 units. *Lacy*

**248. The Theology of Karl Barth.** A historical and critical study of the theology of Karl Barth. Prerequisite: consent of instructor. One course. (3 graduate units.) *Osborn*

**262. Marxist Ideology and Christian Faith.** Comparative examination of Communist and Christian doctrines, such as man, society, sin, history, and eschatology, together with an introduction to the contemporary dialogue. 3 units. *Lacy*

**272. Topics in Comparative Theology.** Theological categories in Christian and Eastern Religious traditions, focusing on such topics as man, God, salvation, eschatology. One course. (3 graduate units.) *Lawrence and Osborn*

**281. Phenomenology and Religion.** Scheler, E. Strauss, Merleau-Ponty, Ricoeur, Binswanger, or others; their bearing upon religious knowledge and practice. Prerequisite: consent of instructor. 3 units. *Poteat*

**292. Christian Ethics and International Relations.** An examination of Christian attitudes toward such issues as war and peace, the rule of law, foreign aid, and human rights; and the Church's contribution to international policies and institutions. 3 units. *Lacy*

**300. Systematic Theology.** Method and structure of systematic theology, the doctrine of God, theological anthropology, and Christology. 3 units. *Cushman, Herzog, or Langford*

**303. The New Hermeneutic and the Idea of History.** A critical examination of key thinkers in present-day European systematic theology: Fuchs, Ebeling, Moltmann, Ott, and Pannenberg, in the light of Ernst Bloch's philosophy. 3 units. *Herzog*

**320. Theology, Power, and Justice.** Critical examination of a major theme of modern Protestant thought in Hegel, Marx, Schleiermacher, and Tillich. 3 units. *Herzog*

**322. Nineteenth Century European Theology.** Protestant theology from Kant to Herrmann. 3 units. *Herzog*

**325. Philosophical Theology I.** Theology, as the knowledge of God, considered in dialogue with selected pagan and Christian philosophers from Plato to Kant. 3 units. *Cushman*

**326. Philosophical Theology II.** Continuation of Philosophical Theology I. 3 units. *Cushman*



**328. Twentieth Century European Theology.** Critical examination of the thought of selected Protestant theologians from 1900 to 1950. 3 units. *Herzog*

**352. Seminar in Christian Theology.** Research and discussion of a selected problem in the systematic field. 3 units. *Staff*

**360. Special Problems in Religion and Culture.** Intensive investigation of the relations of religion and modernity, using seminal contemporary texts. Topics announced each semester. Prerequisite: consent of instructor. 3 units. *Poteat*

**361. Language and Biblical Criticism.** An attempt to explore the bearing of recent investigators into the nature of language upon problems in the study of Biblical texts. Prerequisite: consent of both instructors. 3 units. *Poteat and Charlesworth*

**377. Contemporary American Dramatic Arts and Evolving Theological Forms.** An examination of creed and ritual implicit and explicit in contemporary American theater, film, and television. 3 units. *Henry*

**380. Existentialist Thought.** An exploration of the interests and motifs of Existentialism in relation to modern philosophy and theology through an analysis of representative writings of Kierkegaard, Heidegger, Berdyaev, Marcel, and Sartre. 3 units. *Poteat*

**383. Moral Theology in the Twentieth Century.** Critical and comparative examination of ethical theory as exhibited in the work of selected contemporary theologians. 3 units. *H. Smith*

**386. Christianity in Dialogue with Other Faiths.** Contemporary currents of Christian thought as they affect resurgent non-Christian faiths, new formulations of a theology of mission, and ecumenical conversations. 3 units. *Lacy*

**388. Ethics and Medicine.** A critical study of selected aspects of modern biomedical technology, with special reference to the ethical assumptions informing their development and practice. 3 units. *H. Smith*

**389. Christian Ethics and Contemporary Culture.** A study of the interaction between Christian thought and current social theory. 3 units. *Beach*

**390. Current Problems in Christian Ethical Theory.** A critical study of dominant issues in Christian ethics, such as community, conscience, contextualism, power, and technology. 3 units. *Beach*

**394. Christianity and the State.** The relation of the Christian theory of the state to political problems, with special consideration of the religious assumptions underlying democratic theory and practice and of the relationship of church to state. 3 units. *Beach*

**397. Contemporary American Theology.** A critical appraisal of major tendencies. 3 units. *Henry*

**398. Colloquium on the College and University Teaching of Religion.** A consideration of the curricular content and method in the teaching of religion courses. *M. Smith and others.*

## Romance Languages

Professor Tetel, *Chairman* (205 Foreign Languages); Associate Professor Vincent, *Director of Graduate Studies* (214 Foreign Languages); Professors Cordle, Davis, Fein, Fowlie, Niess, Predmore, and Wardropper; Associate Professors Garcí-Gómez, Hull, and Stewart; Assistant Professors Caserta, Fielding and Landeira

The Department of Romance Languages offers graduate work leading to the A.M., M.A.T., and Ph.D. degrees in French and Spanish. Requirements for the A.M. may be completed by submission of a thesis or by passing a comprehensive examination in the major field. It is hoped that candidates for the A.M. and Ph.D. degree will take related work in a second Romance language; however, related work may be taken in any one or two of a number of other subject areas.

In order to undertake graduate study in Romance languages, the entering student should have credit for at least 18 semester hours (or equivalent) above the intermediate level in the major language.

## FRENCH

### For Seniors and Graduates

**210. The Structure of French.** Modern French phonology, morphology, and syntax. Readings in current linguistic theory. One course. (3 graduate units.) *Hull*

**213, 214. French Literature of the Seventeenth Century.** First semester: theater. Readings in the dramatic literature of the century. Second semester: prose and nondramatic poetry. Readings in baroque and *précieux* poetry, the novel and moralists. Two courses. (6 graduate units.) *Staff*

**217. French Symbolism.** The poetry and theories of Baudelaire, Mallarmé and Rimbaud. Decadence: Laureamont and Laforgue. One course. (3 graduate units.) *Fowlie*

**219. Old French Literature.** An introduction to the reading of Old French literary texts. One course. (3 graduate units.) *Vincent*

**220. French Pre-Romantic and Romantic Poetry.** Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. One course. (3 graduate units.) *Niess*

**221, 222. The Nineteenth Century French Novel.** First semester: Romanticism and Romantic Realism, studies especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. Two courses. (6 graduate units.) *Niess*

**223. Structuralism and the New Criticism.** Backgrounds of the New Criticism and its contemporary practice: psychoanalysis (Jung, Freud); archetypes (Bodkin); existentialism (Sartre); myth and ritual (Frazer, Harrison, etc.); structuralism in anthropology (Levi-Strauss); structuralism in literary criticism (Barthes, Starobinski, Rousset, etc.). To be conducted in English. Readings in English or French. One course. (3 graduate units.) *Fowlie*

**224. History of the French Language.** The evolution of French from Latin to its present form; internal developments and external influences. One course. (3 graduate units.) *Hull*

**225. French Prose of the Sixteenth Century.** Rabelais, Marguerite de Navarre, and Montaigne, and others. One course. (3 graduate units.) *Tetel*

**226. French Poetry of the Sixteenth Century.** A critical appraisal of Villon, Marot, the École Lyonnaise, the Pléiade, and the Baroque poets. One course. (3 graduate units.) *Tetel*

**228. French Poetry of the Twentieth Century.** In the wake of symbolism; Valéry and Claudel; poetry as ritual, Péguy; Appollinaire and surrealist poetry; the contemporary movement, Michaux, Char, Saint-John Perse. One course. (3 graduate units.) *Fowlie*

**233. Contemporary French Theater.** A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. One course. (3 graduate units.) *Fowlie*

**234. Proust.** A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. One course. (3 graduate units.) *Fowlie*

**241, 242. French Literature of the Eighteenth Century.** First semester: the literature of the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. Two courses. (6 graduate units.) *Stewart*

**245, 246. French Literature of the Twentieth Century.** First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. Two courses. (6 graduate units.) *Cordle*

### For Graduates

**311, 312. French Seminar.** Each semester one of the following topics will be selected for intensive treatment: studies in sixteenth century literature, studies in eighteenth century literature, studies in nineteenth century literature, studies in seventeenth century literature, studies in contemporary literature, studies in medieval literature. 3 units per semester. *Cordle, Fowlie, Niess, Stewart, Tetel, and Vincent*

— **Graduate Reading Course.** An intensive course in French to develop rapidly the ability to read French in several fields. Graduate students only. No credit.

## ITALIAN

### For Seniors and Graduates

**283. Italian Novel of the Novecento.** Representative novelists from Svevo to the most recent writers. One course. (3 graduate units.) *Caserta*

**284. Dante.** *La Vita Nuova* and a close reading of the *Inferno*. Conducted in English. One course. (3 graduate units.) *Fowlie*

**285. Dante.** The *Purgatorio* and the *Paradiso* in the light of Dante's cultural world. Special attention will be given to the poetic significance of the *Commedia*. Prerequisite: Italian 284 or equivalent. One course. (3 graduate units.) *Caserta*

**288. The Renaissance.** Petrarch, Boccaccio, and Ariosto. One course. (3 graduate units.) *Tetel*

## SPANISH

### For Seniors and Graduates

**251. The Origins of Spanish Prose Fiction.** A critical study based on close readings and discussions of selected examples of the principal genres of the romance and the novel: the *Amadis de Gaula*, Diego de San Pedro's *La cárcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. One course. (3 graduate units.) *Wardropper*

**252. Spanish Lyric Poetry Before 1700.** A critical study, based on close reading and discussion, of selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor*, *la poesía de tipo tradicional*, and

Santillana; on Garcilaso, San Juan de la Cruz, Fray Luis de León and Herrera; on Góngora and Quevedo. One course. (3 graduate units.) *Wardropper*

**253. The Origins of the Spanish Theater.** A study of the evolution of the Spanish theater from *Auto de los Reyes Magos* (twelfth century) through the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading of texts by Gómez Manrique, Encina, Gil Vicente, Torres Naharro, Lope de Rueda, Juan de la Cueva. One course. (3 graduate units.) *Wardropper*

**255, 256. Modern and Contemporary Spanish American Literature.** First semester: poetry from *Modernismo* to the present. Second semester: twentieth century fiction. One course. (3 graduate units.) *Fein*

**257. Old Spanish Language.** The historical development of the language together with illustrative readings. One course. (3 graduate units.) *Davis*

**258. Medieval Literature.** An introduction to medieval Spanish texts. One course. (3 graduate units.) *Davis or Garci-Gómez*

**259. Spanish Phonetics.** A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. One course. (3 graduate units.) *Predmore*

**260. Origins and Development of Spanish Romanticism.** Representative authors, including Espronceda, Rivas, Zorrilla, Bécquer, and Rosalía de Castro, with a stress on drama and poetry. One course. (3 graduate units.) *Landeira*

**261. Nineteenth Century Novel.** A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibáñez, and their contemporaries. One course. (3 graduate units.) *Davis*

**262. Galdós.** Works selected from the *Novelas contemporáneas*, the *Episodios nacionales*, and his drama. One course. (3 graduate units.) *Davis*

**265. Cervantes.** The life and works of Cervantes with special emphasis on his *Quijote*. One course. (3 graduate units.) *Predmore or Wardropper*

**266. Drama of the Golden Age.** Study of the chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. One course. (3 graduate units.) *Wardropper*

**275, 276. Contemporary Spanish Literature.** First semester: the essay and lyric poetry. A study of the revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester: a study of tradition and innovation in the twentieth century Spanish novel with emphasis on the novels of Unamuno, Baroja, Valle Inclán, and Pérez de Ayala. Two courses. (6 graduate units.) *Predmore*

### For Graduates

**321, 322. Hispanic Seminar.** Each semester one of the following topics will be selected for intensive treatment: the Spanish language in America, studies in medieval literature, studies in the literature of the Golden Age, studies in Latin American literature, studies in the Spanish Renaissance and Baroque, studies in Spanish poetry, studies in nineteenth century Spanish literature, and studies in twentieth century literature. Two courses. (6 graduate units.) *Davis, Fein, Garci-Gómez, Landeira, Predmore, and Wardropper*



## ROMANCE LANGUAGES

**218. The Teaching of Romance Languages.** Evaluation of objectives and methods; practical problems of language teaching at the elementary, secondary, and college levels; analysis of textbooks, texts, and audiovisual aids; applied linguistics. One course. (3 graduate units.) *Hull*

## Slavic Languages and Literatures

Professor Krynski, *Chairman* (314 Foreign Languages); Associate Professor Jezierski, *Director of Graduate Studies*

The Department of Slavic Languages and Literature inaugurated in 1971 a graduate program leading to the A.M. degree. Initially, graduate students will be able to major only in Russian language and literature, but there will be limited training in the language and literature of Poland.

Applicants should have sufficient undergraduate preparation in the Russian language to enable them to read Russian classical literature in the original.

### For Seniors and Graduates

**201, 202. Russian Novel of the Nineteenth Century.** First semester: 1830-1870. Second semester: 1870-1900. Prerequisite 161, 162 or equivalent. Two courses. (6 graduate units.) *Krynski*

**205. The Structure of Polish in Relation to Russian.** Comparative and contrastive study of the two major Slavic languages. Emphasis on preparing students to read Polish literary texts. One course. (3 graduate units.) *Krynski*

**206. Readings in Contemporary Polish Prose in the Original.** Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski and short stories by Slawomir Mrozek and Marek Hlasko. One course. (3 graduate units.) *Krynski*

**207. Soviet Literature and Culture.** Literature since 1917. Readings in English from major works of prose, poetry, and drama. One course. (3 graduate units.) *Jezierski*

**207P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literatures 207. *Jezierski*

**212. Pushkin.** Survey of life and works, his role as precursor of modern Russian literature. Readings in English and Russian. Prerequisite: Russian 101 or consent of instructor. One course. (3 graduate units.) *Krynski*

**225S. Tolstoy.** *War and Peace* and other works. Prerequisite: Russian 175S or equivalent. One course. (3 graduate units.) *Jezierski*

**227S. Gogol.** Life and works: short stories, dramas, and the novel. Readings in English or Russian. One course. (3 graduate units.) *Jezierski*

**230. Chekhov.** Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, and Decadent trends in Russian literature. One course. (3 graduate units.) *Jezierski*

**230P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literature 230. *Jezierski*

**232. Dostoevsky.** Emphasis on *Brothers Karamazov* and the theory of the novel. Prerequisite Russian 176, or equivalent. One course. (3 graduate units.) *Jezierski*

**236. Russian and Polish Romanticism.** Prose, poetry, and drama of such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski presented against the background of the Romantic movement in Western Europe. One course. (3 graduate units.) *Krynski*

## Sociology

Professor Kerckhoff, *Chairman* (268 Sociology-Psychology Building); Professor Smith, *Director of Graduate Studies* (332 Sociology-Psychology Building); Professors Back, Maddox, McKinney, Myers, Palmore, Portes, Preiss, Roy, and Tiryakian; Associate Professors House, Simpson and Wilson; Assistant Professors Baldigo, Campbell, Evers, Hirschman and Rice

The department offers graduate work leading to a Ph.D. degree in sociology. Before undertaking advanced work in this department, a student must have completed a minimum of 12 semester hours of approved preliminary courses in sociology, and an additional 12 semester hours in related work. Applicants for admission should submit scores on the Graduate Record Examination, especially the Aptitude Test.

Increasingly the department is concentrating its training in three programs: Sociology of Human Development; Demography and Ecology; and Social Structure and Social Change. Students who enter without having chosen a program have their first year to do so if entering with the bachelor's degree or their first semester if entering with a master's degree. Each program has its own course requirements, but all share a six course requirement covering theory (281) and methodology (295), research methods and techniques (291, 292), and statistics (293, 294). In addition, each program has an informal seminar series and expects extensive student involvement in the research activities of program faculty. All students are expected to participate for training purposes in the teaching program of the department. In order to assure some breadth of training, all students are required to take at least two departmental courses outside the specific course requirements of both their chosen program and the departmental core requirement. Two or four additional courses outside the department in related work are also required.

There is a qualifying procedure after three semesters, or the equivalent, to determine whether the student can proceed to the preliminary examination. The latter is an oral examination on a written paper that reviews substantive, theoretical, and empirical aspects of a special field chosen by the student and accepted by the student's examining committee. Further details concerning the general departmental program, the three specialized programs, departmental facilities, the staff, ongoing research, and various stipends available may be obtained from the Director of Graduate Studies.

### For Graduates and Seniors

**225. Medical Sociology.** Current issues in the organization, development and the utilization of resources for health care. One course. (3 graduate units.) *Back or Maddox*

**230. Social Aspects of Aging and Death.** Theories of human aging; social problems caused by increased longevity, discrimination against the aged, retirement, widowhood, and other role losses. Social-psychological factors in mortality, accidental death, suicide, and murder. One course. (3 graduate units.) *Palmore*

**241. Social Stratification.** The nature of hierarchical and vertical differentiation for the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on

social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. One course. (3 graduate units.) *Campbell, Evers, or Roy*

**242. The Sociology of Occupations and Professions.** The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, and social organization of occupational groups. One course. (3 graduate units.) *Roy or Simpson*

**243. Population Dynamics and Social Change.** Social scientific aspects of the determinants and consequences of population trends. One course. (3 graduate units.) *Evers, Hirschman, or Myers*

**244. Human Ecology and Urban Systems.** Origins and development of human ecology theory, growth of cities and urban systems, residential segregation of social classes and racial and ethnic groups. One course. (3 graduate units.) *Evers, Hirschman, Myers, or Smith*

**246. Population Policy.** Formation, effect, and evaluation. Historical examples of mortality, fertility, migration, and distribution policies. The Malthusian and neo-Malthusian controversies. Psychological, sociological, demographic, and political background. (Also listed as Public Policy Science 246.) One course. (3 graduate units.) *Back*

**251. The Sociology of Modernization.** Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries. One course. (3 graduate units.) *Hirschman, Portes, or Tiryakian*

**255. Race and Culture.** A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. One course. (3 graduate units.) *Hirschman*

**259. Religion and Social Change.** The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). One course. (3 graduate units.) *Tiryakian or Wilson*

**260. Science, Technology, and Society.** Science as a social phenomenon. Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. One course. (3 graduate units.) *McKinney*

**261. Science, Politics, and Government.** The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Science 255 and Psychology 261.) One course. (3 graduate units.) *Bevan or McKinney*

**272. The Socialization Process.** Mechanisms and variations in socialization by position in the social structure (class, race, urban-rural); contributions made by various socialization agencies (family, school, peer groups, mass media) in Western society. One course. (3 graduate units.) *Baldigo and Kerckhoff*

**275. Social Structure and Personality.** Processes by which social structures and social change (including class, modernization, societal, and organizational membership) affect individual attitudes and behaviors. Nature and effect of stress, alienation, and other forms of incongruence between individuals and social structures. One course. (3 graduate units.) *House or Portes*

**276. Small Groups and Social Life.** A systems theoretical approach. Basic

group processes including communication, integration, sub-group formation, specialization, hierarchy, and leadership; different types, contexts and inter-relations of groups. One course. (3 graduate units.) *Back*

**278. Social Structure and the Life Cycle.** Relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. One course. (3 graduate units.) *Maddox*

**281. Development of Sociological Theory.** Development, convergence, and utilization of sociological theories. One course. (3 graduate units.) *Tiryakian or Wilson*

**291. Research Methods and Techniques I.** Principles and methods of collecting and utilizing questionnaire and survey data. Application of methods in secondary analysis, laboratory and field experimentation, observation and other types of research. Prerequisite: Sociology 132 or 293 or equivalent. One course. (3 graduate units.) *Evers, House, Portes, or Smith*

**292. Research Methods and Techniques II.** Principles, methods and applications of depth interviewing, participant observation, content and analysis, unobtrusive measures, historical and archival analysis. Issues of reliability, validity, quantification, multiple methodologies, and the interrelationship of theory and method. One course. (3 graduate units.) *Baldigo or Roy*

**293. Introductory Statistical Analysis.** Basic descriptive statistics, regression and correlation, t-tests and the analysis of variance, chi square techniques, and other topics. Stress on practical applications. Statistical computing using SPSS and other programs. One course (3 graduate units.) *Campbell*

**294. Intermediate Statistical Analysis.** The general linear model and its application in methods of multivariate statistical analysis: analysis of variance and co-variance, multiple regression and path analysis, and log-linear models for categorical data. Statistical computing using SPSS and other programs. Prerequisite: Sociology 293 or equivalent. One course. (3 graduate units.) *Campbell or Rice*

**295. Methodology in Sociology.** The nature of scientific method, as well as alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation for both general research design and specific techniques. The process and logic of data analysis. Relations of theory and research are stressed. One course. (3 graduate units.) *Back or Smith*

**298S, 299S. Seminar in Selected Topics.** Substantive, theoretical, or methodological topics. Two courses. (3 graduate units per semester.) *Staff*

## For Graduates

**301. Seminar in Human Fertility.** Special topics in human fertility including: theory of demographic transition, fertility in Latin America, design and evaluation of family planning programs, fertility and problems of modernization, and family structure and fertility. 3 units. *Back*

**302. Seminar in Migration.** Special topics in migration including: Latin American rural-urban migration, urban migration policy, contemporary migration theories, and international migration. 3 units. *Myers or Smith*

**325. Social Aspects of Mental Illness and Treatment.** An examination and critique of sociological research and theory in the epidemiology, etiology and treatment of mental illness. Such topics as the effect of mental illness on the



family, the structure and function of various treatment systems and major problems of methodology will receive emphasis. 3 units. *Back or Preiss*

**341. Special Problems of Complex Systems.** (a) *Industrial and Professional Systems.* Analysis of problems of organization of work in such diverse settings as industrial plants, hospitals, and public administration groups. Problems of decision-making, recruitment, allocation of authority, informal organization, inter-organizational relations. 3 units. *McKinney, Roy, or Simpson*

(b) *Mass Communications.* Theoretical problems in defining and distinguishing communication, communicative acts, communication processes, and communication systems. Work aimed toward the derivation of models and theories for each of these will be pursued. 3 units. *Smith*

(c) *Urban Society.* Analysis of the varying mechanisms through which urban society is integrated, how urbanites develop a sense of identification with the community, the extent and mode of social dominance of the city in the larger society. 3 units. *Myers or Smith*

**344. Workshop on Computer Models of Social Systems.** The methodology of building mathematical and logical models of social systems and computer simulation experiments with such models. The types of models and social systems surveyed have applications in business administration, economics, education, political science, psychiatry, psychology, and sociology. Participants in the workshop will develop and conduct simulation experiments with a model of some complex social systems, such as a city, state, region, or nation. (Also listed as Economics 344 and Computer Science 344.) 3 units. *Naylor*

**345, 346. Demographic Techniques I and II.** Measurement and methodology in demography. The first course deals primarily with basic measurement techniques including standardization, construction of the life table, period and cohort measures of fertility, and introduction to classical population theory. The second is devoted to the analysis of complex models such as family building models and growth and projection models and the preparation of a research topic. (Also listed as Economics 345, 346.) 3 units per semester. *Evers or Myers*

**349, 350. Seminar in Selected Topics of Demography and Ecology.** Social, economic, and environmental determinants or consequences of population structure and trends. A broad, multi-disciplinary, cross-national and processual perspective is stressed. 3 units. *Staff*

**351, 352. Seminar in Social Organization.** Examination of such problems as the bases of social cohesion and continuity, the sources and effectiveness of social control mechanisms, the problem of social change in structural-functional theory. 3 units per semester. *Maddox and McKinney*

**373, 374. Social Psychological Issues in Sociology.** Detailed exploration of selected problem areas such as the theory and measurement of social attitudes, role discontinuity and personality disorders, applications of reference group theory, the socialization process. 3 units per semester. *Back, House, Kerckhoff, and Preiss*

**385. Seminar in Sociological Theory.** Analysis of methodological and substantive problems in utilizing comprehensive, middle-range, and discrete theories in varied sociological areas. Major emphasis on the use of theory in empirical research. Prerequisite: Sociology 281 of equivalent. 3 units. *McKinney and Tiryakian*

**386. Seminar in Sociological Theory.** Focuses on the theoretical and research implications of existential phenomenology, drawing from such sources as Husserl, Merleau-Ponty, and Schutz. Attention will be given to recent socio-

logical interests in this area (e.g., ethnomethodology.) Prerequisite: Sociology 281 or equivalent. 3 units. *Tiryakian*

**390. Seminar in Field Methods of Sociological Research.** The primary aims of this course will be two-fold, (a) to consider at length and in detail various procedures and problems of observing human behavior in natural group, organizational, and community settings, and (b) to give the neophyte researcher elementary training in first-hand observation and face-to-face interviewing. 3 units. *Roy*

**392. Individual Research in Sociology.** Students will conduct on an individual basis research designed to evaluate a sociological hypothesis of their choice. The process must be completed by preparation of a report on this research in adequate professional style. Prerequisite: Sociology 295 or consent of instructor. 3 units. *Back or Smith*

**397, 398. Seminar in Special Research.** 3 units per semester. *Staff*

**402. Interdisciplinary Seminar in the History of the Social Sciences.** A survey of the theories, methods, and tools applied to problems in the history of the social sciences. 3 units. *Goodwin, Holley, and Spragens*

## Zoology

Professor Fluke, *Chairman* (227 Biological Sciences Building); Associate Professor Wainwright, *Director of Graduate Studies* (024 Biological Sciences Building); Professors Bailey, Bookhout, Costlow, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Tucker, and K. Wilbur; Associate Professors Barber, Lundberg, Sutherland, Vogel, and Ward; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Bergeron, Forward, McClay, Storey, and H. Wilbur

The Department of Zoology manages a variety of programs tailored to individual needs of students seeking A.M. or Ph.D. degrees.

In general, a student entering the department will be equipped to pursue an advanced degree if he has completed an undergraduate major in biology along with some formal training in college-level chemistry, mathematics, physics, and foreign languages.

Nevertheless, in recognition and support of the modern trend toward interdisciplinary research, the department is prepared to accept promising students with less orthodox academic backgrounds and is ready to encourage any student wishing to undertake a program of study leading, in effect, to an interdisciplinary degree sponsored by the department.

Thus, all students are urged to search widely in the *Bulletin of Undergraduate Instruction* and the *Bulletin of the Graduate School* for information about the intellectual resources of the University. Special attention should be given to announcements of the Departments of Anatomy, Anthropology, Biochemistry, Botany, Chemistry, Geology, History, Mathematics, Microbiology and Immunology, Philosophy, Physiology and Pharmacology, Psychology, Sociology, and Zoology; announcements of the Schools of Engineering and Forestry should also be consulted.

### For Seniors and Graduates

The L suffix on a Zoology course number indicates that the course includes a laboratory.

**201L. Animal Behavior.** Emphasis on recent physiological and developmental studies. Prerequisites: physiology, genetics, and evolution, or consent of instructor. One course. (4 graduate units.) *Klopfer*

**202L. Introduction to Comparative Behavior.** Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Prerequisite: one course in physiology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Salamon (Visiting Summer Faculty)*

**203L. Marine Ecology.** Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology and calculus. Knowledge of statistics helpful. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Sutherland*

**204L. Population and Community Ecology.** Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or consent of instructor. One course. (4 graduate units.) *H. Wilbur*

**205. Elements of Theoretical Biology.** An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: introductory biology and mathematics, or consent of instructor. One course. (3 graduate units.) *Gregg*

**214L. Biological Oceanography.** Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of biological productivity of the continental shelf ecosystem. Prerequisite: consent of instructor. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barber*

**216L. Limnology.** Lakes, ponds, and streams; their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities. Lectures, field trips, and laboratories. Offered in alternate years. Prerequisites: introductory biology, Chemistry 12, physics, and Mathematics 31, or consent of instructor. One course. (4 graduate units.) *Livingstone*

**218L. Paleobiology.** The dynamics of past ecosystems; climatology and ecological geography of the past few million years; laboratory study of lake-bed deposits with emphasis on Quaternary pollen grains. Prerequisites: consent of instructor and a course in ecology. One course. (4 graduate units.) *Livingstone*

**224L. Vertebrate Natural History.** Life histories, adaptations, ecology and classification of vertebrate animals. Prerequisite: Zoology 108. One course. (4 graduate units.) *Bailey*

**229. Morphogenetic Systems.** Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: introductory biology. One course. (3 graduate units.) *Gregg*

**235. Evolutionary Systematics.** Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186,



Zoology 286. Lectures. Prerequisite: introductory biology. (Also listed as Botany 135, Botany 235, and Zoology 135.) One course. (3 graduate units.) *Bailey, Lundberg, or Stone (Botany)*

**235L. Evolutionary Systematics.** See Zoology 235. Lectures and laboratories. One course. (4 graduate units.) *Bailey, Lundberg, or Stone (Botany)*

**238L. Systematic Zoology.** Theory and practice of collection, identification, and classification of animals. Prerequisite: introductory biology. One course. (4 graduate units.) *Bailey*

**239S. Biogeography.** Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics, and dispersal. Prerequisite: consent of instructor. One course. (3 graduate units.) *Bailey*

**245. Radiation Biology.** Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: physics, Mathematics 32, and Chemistry 12. One course. (3 graduate units.) *Fluke*

**246. Physical Biology.** Biomechanics, physical optics and other physical topics applied to living organisms and systems at various levels of organization. Prerequisites: Mathematics 32, Chemistry 12, physics, and one biology course beyond the introductory level, or consent of instructor. One course. (3 graduate units.) *Fluke and Wainwright*

**250L. Physiological Ecology of Marine Animals.** The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) One and one half course. (6 graduate units.) *Forward*

**252. Comparative Physiology.** The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. One course. (4 graduate units.) *Schmidt-Nielsen*

**254S. Fluid Flow and Living Systems.** Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: physics and Mathematics 31, or their equivalents. One course. (3 graduate units.) *Vogel*

**258L. Laboratory Research Methods.** Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy, X-ray diffraction, gel electrophoresis, isolation of cell components, and other methods. Students may select methods according to their interests and research needs. Prerequisite: consent of instructor. Credits to be arranged. 1-4 units. *K. Wilbur and Staff*

**260. Advanced Cell Biology.** Structural and functional organization of cells and their components, emphasizing current research problems and prospects. Prerequisites: introductory cell biology (or genetics and consent of instructor) introductory biochemistry recommended (may be taken concurrently). One course. (3 graduate units.) *Nicklas, K. Wilbur, and Staff*

**262L. Cytological Materials and Methods.** Cytological analysis, with emphasis on chromosome studies using advanced optical, cytochemical, and experimental techniques. Offered in alternate years. Prerequisite: Zoology 260 or equivalent (may be taken concurrently). One course. (3 graduate units.) *Nicklas*

**265S, 266S. Seminar in Chromosome Biology.** Current research in chromo-



some structure and function, mitosis, and meiosis. Prerequisites: a course in cell biology or genetics and consent of instructor. (Also listed as Anatomy 265, 266.) Two half courses. (2 units per semester.) *Moses (Anatomy) and Nicklas*

**274L. Marine Invertebrate Zoology.** Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: introductory biology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barnes (Visiting Summer Faculty)*

**275L. Invertebrate Zoology.** Free-living and parasitic invertebrates. Lectures, readings, and laboratories; field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174, or 274. Prerequisite: introductory biology. (Also listed as Zoology 175.) One course. (4 graduate units.) *Staff*

**277L. Endocrinology of Marine Animals.** Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals, primarily invertebrates. Offered in alternate years. Prerequisite: one course in physiology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Staff*

**278L. Invertebrate Embryology.** Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisites: consent of instructor. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Bookhout*

**280. Principles of Genetics.** Structure and properties of genes and chromosomes and evolution of genetic systems. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or their equivalents. (Also listed as Botany 180, Botany 280, Zoology 180, and under the University Program in Genetics.) One course. (3 graduate units.) *Antonovics (Botany), Boynton (Botany), and Gillham*

**286. Evolutionary Mechanism.** Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135, Botany 235, Zoology 135, Zoology 235. Prerequisite: introductory biology. (Also listed as Botany 186, Botany 286, Zoology 186, and under the University Program in Genetics.) One course. (3 graduate units.) *Antonovics (Botany) and H. Wilbur*

**288S. The Cell in Development and Heredity.** A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. (Also listed as Anatomy 288.) Half course. (2 graduate units.) *Counce (Anatomy)*

**295S, 296S. Seminar.** Topics, instructors, and course credits announced each semester. *Staff*

## For Graduates

**351, 352. Departmental Seminar.** A weekly meeting of graduate students and faculty to hear and discuss research reports. 1 unit credit by arrangement. *Staff and Invited Lecturers*

**353, 354. Research.** To be carried on under the direction of the appropriate staff members. Hours and credits to be arranged. *Staff*

**355, 356. Seminar.** One or more seminar courses in particular fields are given each semester by various members of the staff. 2 units. *Staff*

**360, 361. Tutorials.** Students will write essays based on reading of literature. Essays will be discussed and critically evaluated in meetings. 2 units per semester. *Staff*

**Genetics, The University Program.** Genetics courses offered by the Department of Zoology are part of The University Program in Genetics; see announcement in this *Bulletin*.

**Marine Laboratory.** Consult Marine Sciences in this *Bulletin* for offerings at the Duke University Laboratory.

**Program in Tropical Biology.** Fellowships are available for travel and subsistence in field-oriented programs in Latin America. Refer to the section Organization for Tropical Studies in this *Bulletin* in the chapter on Special and Cooperative Programs.





# Appendix

## ADVANCED DEGREES CONFERRED MAY 11, 1975

### Master of Arts

Akers, Frank H., Jr.  
Al-Farsy, Fouad Abdelsalam  
Al-Rawaf, Othman Yasin  
Ames, James Edward, IV  
Andrien, Kenneth James  
Baily, Charles Michael  
Barling, Lesley Ann  
Barnett, David Zane  
Basha, Claire Frances  
Bausor, Randall Sydney  
Bland, Robert Neal  
Broussard, Albert S.  
Brown, Kendall Walker  
Butts, Donald Cleveland  
Callihan, Henry Clay, Jr.  
Cappel, Timothy R.  
Chen, Meei-Hwa  
Cohen, Zelda Berman  
Daniel, Dawn Alicia  
deAlmeida, Eleanor Engram  
Draper, Sara J.  
Fick, Johan Christian  
Finch, Robert Paul  
Fisher, Suzanne

Fitzwater, Larry Alan  
Hollaway, Stephen Eugene  
Horney, Mary Jean  
Hurd, Peter DeWitt  
Jefferson, Alphine Wade  
Jeffries, William C., Jr.  
Johnson, Carol Elizabeth  
Johnson, Edward Coleman  
Johnson, Gloria Alyce  
Jong, Weicherng  
Kaempfer, William Hutchison  
Katz, Paul  
Kobayaski, Hideichiro  
Kravitz, Frederick Mark  
Landerman, Lawrence R.  
Later, Michael Monte  
Lawson, Jasper Jones  
Leaper, Richard John  
Mayer, Michael Sobeloff  
Melville, Thomas Richard  
Mencin, Gary S.  
Miller, Cynthia Ann  
Morefield, Roger Dale  
Nance, Leonard L.

Nesmith, Vardell Edwards, Jr.  
O'Neill, Seamus  
Ong, Chit Chung  
Phillips, David Rawson  
Radcliffe, Ronald Wayne  
Reynolds, Jon Anzuena  
Rittenberg, David Jonathan  
Roe, Robert David  
Rogers, Ronald Cary  
Satterfield, Robert Beeler  
Schmickle, William Edgar  
Secleter, Judith A.  
Simon, Jesse A.  
Smith, Jeffrey Lake  
Somers, George Warren  
Stephens, Julianne C.  
Swartz, Caroline  
Utley, Robert Lashlee, Jr.  
von Ramm, Angelika Ingeborg  
Konstanze Langen  
Webber, Stephen Bolt  
Zucker, Charles Samuel

### Master of Arts in Teaching

Best, Jo Ellen  
Boyum, Richard Craig  
Brownlee, Elisabeth Raleigh  
Burch, Deborah Faith

Grass, Randall Fernand  
Green, Gloria Kickel  
Jones, Edith Fayssdux  
Juba, Richard Louis

Reeves, Charles Daniel  
Rudd, Orrin Kenneth, III  
Stein, Mark Theodore  
Thigpen, Susan Barbara

### Master of Education

Abbott, Jay Dean  
Bell, Bettye Jo  
Bordeaux, Iris Daye  
Boyd, Earnstine  
Claybrook, Laurelyn Domeck  
Colvin, Jesse Michael  
Cortes, Patricia  
Davis, Thomas Whitmell  
Ellis, David Welford  
Hartley, Mary Frances Atwater  
Jackson, James Kevin

Johnson, Morris W., Jr.  
Konowalow, Stephen  
Lerch, Justine Fredericks  
Levanti, Thomas Peter, Jr.  
Madey, Doren Louise  
Markham, Mary Elizabeth  
McLeod, Augustus Dixon  
Novack, Susan Deborah  
Paulson, Beverly Moore  
Rentschler, Donald Richard  
Robinson, Sandra Longfellow

Runo, Karen Marie Esagro  
Schnerer, Debra Susan  
Smith, Eric Jensen  
Snyder, Henry B., Jr.  
Spivey, Richard Coleman, Jr.  
Stern, Geri Susan  
Verscharen, Mariann  
Wilson, Edward Smith, III  
Wright, Carol Loker  
Zuker, Raymond Frederick

### Master of Science

Abo-Hamd, Metwally Hasan  
Brennan, Gerard Peter  
Combs, William L.  
Cronin, Theodore Michael  
Cross, William Arthur  
Denby, Gordon Morrison

Henry, Alice Jane  
Hinkle, Dwight Marlin  
Huggins, John R.  
Johnson, Elizabeth Eife  
Kruse, James A.  
Lavoie, Raymond Joseph, Jr.

Lorenz, Carol Elaine  
Mahan, Michael Ray  
Malone, Terry Richard  
Mitchener, James Samuel, III  
Mostafa, Mohamed Talat M.  
Peacock, Randolph Carver



Perry, David Wayne  
 Pruet, Bessie Lynn  
 Rockwell, John Edward, III  
 Rose, Margaret Allie

Roth, Bradford Lee  
 Strole, Norman Clark  
 Trogdon, Steven Arman  
 Turbyfill, Elizabeth Prue

Watts, David Haywood  
 Wedel, Diana Sue

#### Master of Business Administration

Adams, Loren McLean  
 Anthony, Roy Jay  
 Bennett, Daniel Chaplin  
 Bennett, David Paul  
 Bhotika, Santosh C.  
 Bowker, Robert M.  
 Bradbury, Robin Pearson  
 Cahill, George Paul  
 Coleman, William Henry  
 Connor, John Michael  
 Creighton, Russell Lamont  
 Dearing, Ronald Douglas  
 Dev, Nagaraj Ranthi

DeVincintis, Roberto  
 Dragone, Robert M.  
 Dunn, Michael Thomas  
 Frenzel, Joseph William, Jr.  
 Gillespie, Thomas James, IV  
 Gorman, Raymond F., Jr.  
 Heeb, Ben  
 Herr, John Diller  
 Johnson, John William McGee  
 Keel, Walter Malone  
 Lacks, Stephen Ash  
 Layne, Steven Hillis  
 Leighton, John Richard

McLeod, Stephen Jerome  
 McManus, Kevin Joseph  
 Mertzluft, James W.  
 Mlot, Garry Michael  
 Nelson, Kathleen Ann  
 Parrish, Charles Edward  
 Raftelis, George Anthony  
 Sikkell, Mark Allyn  
 Simons, John Oliver, Jr.  
 Tweeddale, Thomas James  
 Voytilla, Robert J.  
 Wilder, Brian Victor

#### Master of Health Administration

Benson, Lawrence Paul  
 Blagg, David Varian, II  
 Burke, Steven Charles  
 Campbell, Carol Lynn  
 Darney, Bruce Steven  
 Falcone, David J.  
 Farnell, Leland Edward  
 Flaherty, Richard Gordon  
 Gabriel, Margaret LeClere

Goldstein, Robert Lee  
 Hagen, Charles Walter  
 Hartmann, Susan Emily  
 Howerton, Richard Thomas, III  
 Lynton, Andrew Edward  
 Mitchell, Catherine Roberts  
 Morgan, Donald Blair  
 Mozynski, Adolph Anthony  
 Nash, John Dennis

Olden, Peter Carter  
 Olivier, John Louis  
 Ostrye, Lawrence Craig  
 Person, Matthew Maurice, III  
 Roquet, Beverly Susan Putnam  
 Walters, Roy Washington, III  
 Wicks, Bruce Arthur  
 Wilmot, David Michael

#### Doctor of Education

Bullard, Elizabeth Moore (A.B., M.Ed., University of North Carolina). *Education*. Dissertation: "Conceptualizing South Asian Culture: A Pedagogical Approach to a Problem in Social Studies."  
 Burch, Donna Arlene Dorfler (A.B., Pomona College; A.M., Mills College). *Education*. Dissertation: "Existing and Needed Instruction in Organic Chemistry in Virginia Schools in Support of Industry in Virginia."  
 Dexter, Beverly Liebherr (B.S., Ohio State University; M.Ed., Ed.S., Georgia State University). *Education*. Dissertation: "Simovation: Experiential Teacher Education Workshops."  
 Downing, Clinton Roosevelt (B.S., M.S., North Carolina A & T University). *Education*. Dissertation: "An Analysis of the Impact of Title I Funds of the Elementary and Secondary Education Act on Instructional Programs of Public Schools in the First Congressional District of North Carolina."  
 Epanchin, Betty Phillips Cooper (A.B., M.Ed., Duke University). *Education*. Dissertation: "The Relationship Between Self-Concept and Reading Achievement During the Elementary School Years."  
 Jenkins, Charles Raymond (B.S., M.A., East Carolina University). *Education*. Dissertation: "A Study of Legal and Administrative Aspects of Desegregation in Public Higher Education With Reference to the University of North Carolina."  
 Jones, Jean Poythress (A.B., Atlantic Christian College; M.Ed., East Carolina University). *Education*. Dissertation: "Differentiated Staffing Model for North Carolina High Schools."  
 Lewis, David Edmund (B. Music, University of Wisconsin; A.M., Northern Michigan University). *Education*. Dissertation: "The Physician's Assistant Concept."  
 McDonald, John Thomas (A.B., Allen University; A.M., New York University). *Education*. Dissertation: "Innovations in the Elementary Schools of Greensboro, North Carolina."  
 Parson, Alice Ann Pangburn (B.S., M.Ed., University of Oklahoma). *Education*. Dissertation: "Problems in Human Communication: A High School Textbook."  
 Pittillo, Elen Sain (A.B., A.M., Furman University). *Education*. Dissertation: "Decision Flow Analysis as Perceived by Different Hierarchical Levels Within a Selected Educational Organization."

- Reed, Gladys Cartwright (B.S., Elizabeth City State University; A.M., Columbia University). *Education*. Dissertation: "An Evaluation of the 1963 and 1973 Long-Range School Facilities Plans of Selected School Systems in North Carolina."
- Rowe, Roy Herbert, Jr. (A.B., University of North Carolina; A.M., Florida State University). *Education*. Dissertation: "Educational Policy-Makers in the North Carolina General Assembly 1933-1974."
- Sartorius, John Churchill (A.B., Davidson College; M.A.T., University of North Carolina). *Education*. Dissertation: "Chief Student Personnel Administrators' Responsibilities for Selected Academic Matters in Public Colleges With Enrollments of 2,000-3,000 Students."
- Webb, David Maryland (A.B., Atlantic Christian College; M.Ed., College of William and Mary). *Education*. Dissertation: "Modern Management Concepts and Practices in North Carolina Local School Systems."

### Doctor of Philosophy

- Akers, Frank H., Jr. (B.S., United States Naval Academy; A.M., Duke University). *History*. Dissertation: "The Unexpected Challenge: The Creek War of 1813-1814."
- Al-Awkati, Zaid Ahmed (B.Sc., Al-Hikma University; M.Sc., University of Florida). *Civil Engineering*. Dissertation: "On Problems of Soil Bearing Capacity at Depth."
- Almeda, Frank, Jr. (A.B., University of South Florida). *Botany*. Dissertation: "A Revision of the Montane-Tropical Genus *Monochaetum* (Melastomataceae) of Mexico and Central America."
- Baldwin, Virgil Clark, Jr. (B.S., University of Utah; M.S., Colorado State University). *Forestry*. Dissertation: "Comparison and Evaluation of Methods Determining Pattern in Stationary Populations."
- Bayless, Charles Eugene (B.S., Purdue University; A.M., Indiana University). *Education*. Dissertation: "An Analysis of the Alienation Motif in Secondary School Literature."
- Blake, Daniel Jackson (B.S., Guilford College). *Physiology and Pharmacology*. Dissertation: "Electrophysiological Study of the Corticocaudate Projection in Cats."
- Blakeslee, George M. (B.S., Albright College; M.F., Duke University). *Forestry*. Dissertation: "Basidiospore Germination and Function in Ectomycorrhizal Synthesis by Certain Members of the Agaricales."
- Blank, Frederick Michael (B.S., M.S., Southern Illinois University; A.M., Duke University). *Economics*. Dissertation: "An Economic Theory of Pollution."
- Brandon, William P. (A.B., Johns Hopkins University; M.Sc., London School of Economics). *Economics*. Dissertation: "Linguistic Analysis, Political Science and Political Theory: Some Applications of Contemporary Anglo-American Philosophy to the Study of Politics and Political Theory."
- Carney, Elizabeth Donnelly (A.B., Smith College). *Classical Studies*. Dissertation: "Alexander the Great and the Macedonian Aristocracy."
- Chauvenet, Paula Hogue (A.B., Case Western Reserve University). *Microbiology and Immunology*. Dissertation: "The Interrelationship Between C57B/6J and H(z1) Mice and Their Tumors."
- Cheney, Paul Ray, Jr. (B.S., Florida Presbyterian College). *Physics*. Dissertation: "A Determination of  $g_J(N14, ^4S_{3/2})$  |  $g_J(RB87, ^2S_{1/2})$ ."
- Cheney, Richard Wentworth, Jr. (B.S., University of Massachusetts). *Biochemistry*. Dissertation: "Studies on the *cysB* Region of *Salmonella typhimurium*."
- Chung, Hsu-Ho (B.S., National Taiwan University; M.S., Duke University). *Forestry*. Dissertation: "Growth, Biochemical Changes, and Photosynthate Allocation in Shoots of *Pinus taeda* L."
- Chung, Kuo-San (B.S., National Taiwan University; M.S., Duke University). *Electrical Engineering*. Dissertation: "Susceptibility of  $GdAl_2$  Based on the RKKY Model."
- Cole, Alex B. (B.S., M.S., University of Missouri). *Forestry*. Dissertation: "Forest Production Industries and the North Carolina Economy."
- Corley, Ronald B. (B.S., Duke University). *Microbiology and Immunology*. Dissertation: "In Vitro Studies on Cellular Responses Against Allogeneic Human Lymphocytes and Lymphoblastoid Cells From Continuous Cell Lines."
- Crowell, James Seibt, Jr. (B.S., Duke University). *Microbiology and Immunology*. Dissertation: "Cell-Mediated Immunity in Vivo: Adoptive Neutralization and the Induction of Tumor Immunity."
- David, John Jefferson (B.S., Duke University, M.Div., Gordon-Conwell Theological Seminary). *Religion*. Dissertation: "Paul Tillich and Religious Socialism."
- Dean, Robert Coulson (A.B., Harvard College). *Zoology*. Dissertation: "Digestion of Cellulose and Wood in the Shipworm *Bankia gouldi* Bartsch."
- Dexter, Caroline Elizabeth (A.B., Manhattanville College). *Classical Studies*. Dissertation: "The Casa di L. Cecilio Giocondo in Pompeii."
- Dey, Jonathan Paul (B.S., Oregon State University; A.M., Duke University). *Botany*. Dissertation: "The Fruticose and Foliose Lichens of the High-Mountain Areas of the Southern Appalachians."

- Díaz, Humberto José (Licenciado Biología, University of Central de Venezuela). *Zoology*. Dissertation: "Life History Pattern and Population Growth of the Mole Crab, *Emerita talpoida* (Say)."
- Dibben, Martyn James (B.Sc., A.M., University of London). *Botany*. Dissertation: "The Chemo-systematics of the Lichen Genus *Pertusaria* in North America North of Mexico."
- English, Peter Calvin (A.B., Duke University). *History*. Dissertation: "George Washington Crile and Surgical Shock: Physiology and Surgery in America, 1888-1918."
- Esslinger, Theodore Lee (A.B., Eastern Washington State College). *Botany*. Dissertation: "A Chemo-systematic Revision of the Brown *Parmeliae*."
- Eylers, John Peter (B.S., Manhattan College). *Zoology*. Dissertation: "The Structural Basis of Stiffness and Flexibility in Starfish."
- Fenton, Charles Stephen (A.B., University of Hull; A.M., McMaster University). *Sociology*. Dissertation: "Work and Social Milieu: Durkheim's Theory of Occupations and the Social Order."
- Flynn, John McGavock (A.B., Marquette University; A.M., Duke University). *Political Science*. Dissertation: "Recommendations for Civil Service Reform in a Technical Age: India, Great Britain, and the United States."
- Franklin, James Lee, Jr. (A.B., Denison University; A.M., Queen's University). *Classical Studies*. Dissertation: "The Chronology and Sequence of Candidacies for the Municipal Magistracies Attested in the Pompeian Parietal Inscriptions A.D. 71-79."
- Frederick, Stephen Carter (A.B., Hamilton College; B.D., Princeton Theological Seminary). *Religion*. Dissertation: "The Theme of Obedience in the First Epistle of Peter."
- Garvey, Robert Michael (B.S., Davidson College). *Physics*. Dissertation: "High Resolution Beam Maser Spectroscopy in the Millimeter and Submillimeter Wave Region."
- Gawley, Robert Edgar (B.S., Stetson University). *Chemistry*. Dissertation: "Photo-Annulations With  $\alpha$ -Formyl Ketones."
- Gilbertsen, Richard Buell (B.S., Beloit College). *Microbiology and Immunology*. Dissertation: "Rosette Studies on Human Lymphocytes."
- Gilman, Lee Barrett (A.B., University of Virginia). *Chemistry*. Dissertation: "Photolysis of Aliphatic Azo Compounds in Solution Studies by ESR."
- Glenn, John Frazier (A.B., University of North Carolina; A.M., Duke University). *Psychology*. Dissertation: "Gastric Modulation of Gustatory Afferent Activity."
- Golden, Susan Landau (A.B., Case Western Reserve University; A.M., Duke University). *English*. Dissertation: "The Novels of Saul Bellow: A Study in Development."
- Gordon, John William (A.B., The Citadel; A.M., Duke University). *History*. Dissertation: "Special Forces for Desert Warfare: British Improvisation, 1915-1943."
- Gough, Robert Anthony, Jr. (A.B., Bates College; A.M., Duke University). *Economics*. Dissertation: "Intergovernmental Grants-in-Aid: A General Model for Assessing the Local Fiscal Effects of the Massachusetts Variable-Matching Public School Aid Program."
- Graham, Marshall Donnie (B.S., M.S., University of Kentucky). *Electrical Engineering*. Dissertation: "A Motion-Compensated Microscope for *in Vivo* Pulmonary Micrography."
- Grant, Michael Clarence (A.B., M.S., Texas Tech University). *Botany*. Dissertation: "Genetic Properties of Ecologically Marginal Populations of *Anthoxanthum odoratum*."
- Graves, James Stephen (B.S., Washington State University). *Physiology and Pharmacology*. Dissertation: "Ion Transport and Electrical Properties of the Marine Alga, *Halicystis parvula*."
- Greeley, Elizabeth Hoffman (B.S., University of Illinois). *Microbiology and Immunology*. Dissertation: "Receptors for Antigen on Lymphoid Cells: A Study of the Nature of Antigen Recognition by Plaque-Forming Cells."
- Grefrath, Stuart P. (B.S., State University of New York). *Physiology and Pharmacology*. Dissertation: "Biological Membranes: Compositional and Structural Analysis."
- Gresham, Charles Arthur (B.S., University of Georgia; M.S., Duke University). *Forestry*. Dissertation: "Stomatal Resistance in a Loblolly Pine Plantation."
- Gupta, Rajinder Mohan (B.S., Louisiana State University; M.S., Duke University). *Electrical Engineering*. Dissertation: "A Model of Indirect Exchange for an Antiferromagnetic Semiconductor."
- Hallahan, Huston Diehl (A.B., Colorado College; A.M., Duke University). *English*. Dissertation: "'Conceits Intellectual to Images Sensible': Emblematic Techniques in Stuart Revenge Tragedy."
- Hanpeter, Frederick Oliver (A.B., College of William and Mary). *Philosophy*. Dissertation: "John Locke and the Corpuscular Theory."
- Hardymon, G. Felda (B.S., Rose Polytechnic Institute; A.M., Duke University). *Mathematics*. Dissertation: "Ellipticity of the Boundary Complex Implies Coercivity of the Neumann Problem."
- Harkins, Elizabeth Bates (B.S.N., University of North Carolina; A.M., Duke University). *Sociology*. Dissertation: "Stress and the Empty Nest Transition: A Study of the Influence of Social and Psychological Factors on Emotional and Physical Health."
- Harwood, Susan Eileen (B.S., M.S., University of Tennessee). *Microbiology and Immunology*. Dissertation: "Radioimmunoassays for Antibodies to Cytomegalovirus."



- Hatting, Steven Hugh (A.B., Nebraska Wesleyan University; A.M., Duke University). *Political Science*. Dissertation: "Judicial Interpretation and Review of Legislative Action in the American States: An Exploration in Role Theory and Analysis."
- Haynes, Edward Sheldon (A.B., A.M., Duke University). *History*. Dissertation: "Jagirdars and Government: The Political Role of the Kinship Elite in Alwar (Rajputana, India), 1858-1910."
- Hebrank, John H. (B.S., Duke University) *Mechanical Engineering and Materials Science*. Dissertation: "The Auditory Perception of Elevation on the Median Plane: A New Theory of Motionless, Vertical Localization."
- Heeren, John William (A.B., A.M., University of California). *Sociology*. Dissertation: "Functional and Critical Sociology: A Study of Two Groups of Contemporary Sociologists."
- Herren, Robert Stanley (A.B., University of South Dakota). *Economics*. Dissertation: "Wage-Price Policy During the Truman Administration: A Postwar Problem and the Search for Its Solution."
- Hildebrandt, William Henry (B.S., Washington State University; M.S., Duke University). *Mechanical Engineering and Materials Science*. Dissertation: "Low Temperature Quantitative Phase Equilibria and Glass Formation in the H<sub>2</sub>O-NaCl-DMSO System."
- Holloway, James Edward, Jr. (A.B., University of Northern Colorado; A.M., University of Wyoming). *Romance Languages*. Dissertation: "Borges' Epiphany: Formulation, Incarnation, Transmutation."
- Horres, Charles Russell, Jr. (B.Ch.E., Georgia Institute of Technology). *Physiology and Pharmacology*. Dissertation: "Potassium Tracer Kinetics of Growth Oriented Heart Cells in Tissue Culture."
- Hoyt, Thomas, Jr. (A.B., Lane College; M.Div., Interdenominational Theological Center; S.T.M., Union Theological Seminary). *Religion*. Dissertation: "The Poor in Luke-Acts."
- Huber, Sally Ann (B.S., Virginia Polytechnic Institute). *Microbiology and Immunology*. Dissertation: "An Investigation into the *in Vitro* Reactivity of Peritoneal Exudate Lymphoid Cells, Mesenteric Lymph Node Cells and Spleen Cells from BALB/c Mice Immune to EL4 Ascites Leukemia."
- Impelman, Dianne Mary Katherine (A.B., University of California). *Physiology and Pharmacology*. Dissertation: "Study of the Neuronal Basis of a Rhythmic Locomotor Behavior in *Aplysia californica*."
- Johe, Richard Edwin (A.B., Dickinson College; A.M., University of Idaho). *Political Science*. Dissertation: "The American Military Establishment: An Investigation of a Conservative Enclave in Liberal America."
- Johnson, David Barton (B.S., University of Rhode Island). *Chemistry*. Dissertation: "Chemical and Biosynthetic Studies of the Sclerium Alkaloids."
- Kronberg, Charles Louis (A.B., Brooklyn College). *Psychology*. Dissertation: "Interpersonal Style and Complementary Response Evocation."
- Lader, James Ira (A.B., University of Pennsylvania; A.M., Duke University). *Romance Languages*. Dissertation: "The Outsider in Zola's *Rougon-Macquart* Series."
- Leavell, James Berry, III (A.B., A.M., Baylor University). *History*. Dissertation: "The Development of the Modern Japanese Police System: Transition from Tokugawa to Meiji."
- Lebo, Roger Van (B.S., Pennsylvania State University). *Zoology*. Dissertation: "Inhibition of r-Glutamyl-Cysteine Synthetase by Cystamine."
- Lee, Shin OK (B.S., Seoul National University; M.S., Howard University). *Chemistry*. Dissertation: "Spectral and Stereochemical Studies of Some Phosphorinane Sulfides."
- Lewis, James Allen (A.B., Ohio State University; A.M., Northern Illinois University). *History*. Dissertation: "New Spain During the American Revolution, 1779-1783: A Viceroyalty at War."
- Linkous, Garland Karr, Jr. (B.S., Virginia Polytechnic Institute; A.M., University of Richmond). *Education*. Dissertation: "An Examination of the Relationships Between Selected Home Environmental Variables and Some Cognitive Performances of Kindergarten Children."
- Lloyd, Stephen Carroll (A.B., Johns Hopkins University). *Computer Science*. Dissertation: "Parallel Computational Schemata (PCS): A Constructively Determinate Model With Dynamic Operand Resolution and Distributed Control."
- Longbotham, Edward Morgan (A.B., Haverford College; M.A.L.S., Wesleyan University). *English*. Dissertation: "Spenser's Paradox of Innocence and Experience in Book I of *The Faerie Queene*."
- Losada, Freddy José (Licenciate, Central University). *Zoology*. Dissertation: "Studies on Growth and Shell Deposition in Barnacles of the Genus *Balanus*."
- Lothman, Eric William (A.B., Duke University). *Physiology and Pharmacology*. Dissertation: "Penicillin-Induced Spinal Epileptiform Activity."
- Loughridge, Dennis Wayne (B.S., Virginia Polytechnic Institute; M.B.A., Duke University). *Business Administration*. Dissertation: "The Coordination of Short-Run Decision Making With Long-Run Planning."
- Loveland, Christine Ann (A.B., Carleton College; A.M., Duke University). *Anthropology*. Dissertation: "Communication in India: Mass Media and Cultural Media."
- Madsen, Stirling Kent (A.B., Brigham Young University; A.M., Duke University). *Romance Languages*. Dissertation: "Alain's *Propos*: Origins and Potentials of the Form."
- McDougall, Derek John (A.B., A.M., University of Melbourne). *Political Science*. Dissertation: "An Analysis of Harold D. Lasswell's Contribution to the Study of World Politics."



- McFadden, Dennis Lee (A.B., College of Wooster). *Chemistry*. Dissertation: "Structural Studies on Some First Row Transition Metal Complexes of 1, 10-Phenanthroline, Imidazole, and Dimethylglyoxime."
- Meredith, Robert Leonard (A.B., University of Kansas; A.M., Duke University). *English*. Dissertation: "Charles Lever: Anglo-Irish Novelist."
- Moses, Arthur Laurence (A.B., Franklin and Marshall College; A.M., Duke University). *Economics*. Dissertation: "Projections of the Energy Base of the Soviet Transport Sector."
- Mowbray, James Arthur (Ph.B., A.M., Wayne State University). *History*. Dissertation: "Militiaman: A Comparative Study of the Evolution of Organization in the Canadian and British Voluntary Citizen Military Forces 1896-1939."
- Nagey, David Augustus (B.S., Purdue University). *Biomedical Engineering*. Dissertation: "A Study of Dehydroepiandrosterone to Estrogen Conversion Dynamics in the Third Trimester Pregnant Woman: The Evolution of a Physiological Model and Its Mathematical Representation."
- Nation, Robert Craig (A.B., Villanova University). *History*. Dissertation: "The Zimmerwald Left: The Roots of International Communism in the First World War."
- Nelson, Larry Earl (A.B., Brigham Young University; M.S., University of Utah). *History*. Dissertation: "The Confederacy and the United States Presidential Election of 1864."
- Norris, Margaret Van Antwerp (A.B., Duke University; A.M., Stanford University). *Romance Languages*. Dissertation: "Poetic Traditions of the Spanish Folk."
- Olson, Marilyn Strasser (A.B., Michigan State University; A.M., Duke University). *English*. Dissertation: "Nil Medium: Noble Soldiers in the Drama in English 1625-1660."
- Onan, Kay Denise (A.B., Concordia College). *Chemistry*. Dissertation: "Structural and Conformational Studies by X-Ray Diffraction Methods I. Phosphorus and Sulfur Heterocycles II. Sesquiterpene Lactones."
- Powell, Burt Edward (A.B., University of Washington). *Economics*. Dissertation: "Land Tenure on Northern Plains Indian Reservations."
- Ramsey, Maynard, III (A.B., Emory University; M.D., Duke University). *Biomedical Engineering*. Dissertation: "Comparison of Epicardial Potentials With Measured and Simulated Torso Potentials for Ventricular Depolarization in the Dog."
- Raugi, Gregory John (B.Sc., Brown University). *Physiology and Pharmacology*. Dissertation: "A Quantitative Structural Analysis of Intermediary Metabolism in *Tetrahymena*."
- Richowsky, John Christopher (A.B., Tulane University; A.M., Duke University). *English*. Dissertation: "Toward a Subjective Study of Literature."
- Roberts, David Lee (A.B., University of South Florida; A.M., University of Florida). *Economics*. Dissertation: "Keynes and the System of the Keynesians."
- Rollins, Yvonne Barges (A.B., Université de Clermont-Ferrand; A.M., Brigham Young University). *Romance Languages*. Dissertation: "The Aesthetics of the Grotesque in the Work of Charles Baudelaire."
- Romano, Paula Josephine (A.B., Catholic University). *Microbiology and Immunology*. Dissertation: "Cell Mediated Immunity Studies in Human Leukemia."
- Ruedy, Shirley Wallace (A.B., Wittenberg University; A.M., Duke University). *English*. Dissertation: "Spenser's Britomart."
- Ruth, Robert Douglas (A.B., State University of New York; A.M., Duke University). *Sociology*. Dissertation: "A Study of the Factors Affecting Teacher Attitudes and Participation in the New York City School Decentralization Controversy."
- Sapp, James Stephen (A.B., M.Div., Duke University). *Religion*. Dissertation: "Human Sexuality: A Christian Understanding in Light of Contemporary Science and Theology."
- Scharver, Jeffrey Douglas (B.S., Bowling Green University). *Chemistry*. Dissertation: "Chemical and Biosynthetic Studies of Protoberberine Alkaloids."
- Schmidt, William Frederick, III (B.S., Hobart College). *Physiology and Pharmacology*. Dissertation: "Co-Transport of Sodium Plus Potassium in Duck Red Cells."
- Schneider, Craig William (A.B., Gettysburg College). *Botany*. Dissertation: "Spatial and Temporal Distributions of Benthic Marine Algae on the Continental Shelf of the Carolinas."
- Seaman, Ronald Leon (B.S.E.E., University of Cincinnati). *Biomedical Engineering*. Dissertation: "Neuronal Effects of Low Level Microwaves."
- Searle, John Randolph (B.S., Wake Forest University; B.S., North Carolina State University). *Biomedical Engineering*. Dissertation: "Gas Phase in Tissue: Its Origin, Growth and Measurement During Decompression."
- Seymour, Betty Jean (A.B., Furman University; M.R.E., Southern Baptist Theological Seminary; A.M., University of Richmond). *Religion*. Dissertation: "The Dyer's Hand: Kierkegaardian Perspectives on Person, Word, and Art Re-Discovered in W. H. Auden."
- Shepherd, Neal (A.B., Johns Hopkins University). *Physiology and Pharmacology*. Dissertation: "A Mathematical Model of the Force Frequency Relation in Rabbit Papillary Muscle."
- Smith, Alan Paul (A.B., Erham College; A.M., Duke University). *Botany*. Dissertation: "Population Dynamics and Life Form of *Espeletia* in the Venezuelan Andes."

- Sneiderman, Charles Alan (B.S., University of Maryland). *Pathology*. Dissertation: "Complement and the Lung in Experimental Hemorrhagic Shock."
- Spindel, Donna Jane (A.B., Mount Holyoke College). *History*. Dissertation: "The Stamp Act Riots."
- Spitzer, John Herbert (B.S., Stanford University; M.S., University of Iowa). *Economics*. Dissertation: "The Rates of Return to Capital, Advertising, and Research and Development: Their Sensitivity to the Structure of the Distributed Time Lag."
- Stevens, Jane Sexton (A.B., M.Ed., Duke University). *Education*. Dissertation: "Developmental Changes in Self Concept Over the Elementary School Years."
- Subramanian, Kumar (B. Tech., Indian Institute of Technology; M.S., Duke University) *Electrical Engineering*. Dissertation: "Fault Diagnosis in Microprogrammable Systems: A Graph Theoretical Approach."
- Sud, Ish (B. Tech., Indian Institute of Technology; M.S., Duke University). *Mechanical Engineering and Materials Science*. Dissertation: "An Analysis of Turbulent Fluid Flow and Heat Transfer for Vehicles Travelling in Tubes."
- Suter, Larry Elvin (A.B., College of Idaho; A.M., Duke University). *Sociology*. Dissertation: "Migration and Occupational Achievement: A Retrospective Analysis of Migration and Occupational Mobility."
- Swain, Richard Moody, II (B.S., United States Military Academy). *History*. Dissertation: "The Development of a Logistics System for the British Army, 1856-1896."
- Swiger, Ernest Cullimore, Jr. (A.B., Duke University; A.M. University of North Carolina). *History*. Dissertation: "The Big Markets of the Old World: The Canadian Commercial Relations With Europe, 1896-1914."
- Tomesch, John Charles (B.S., St. Peter's College). *Chemistry*. Dissertation: "The Total Synthesis of the Tetracyclic Sesquiterpene *dl*-Cyclosativene."
- Troyer, Michael David (A.B., Cornell University). *Economics*. Dissertation: "Health Care Delivery and a Price Mechanism for Resource Allocation."
- Viti, Robert Michael (A.B., St. Peter's College; A.M. Duke University). *Romance Languages*. Dissertation: "The Road to Self-Governance: A Study of the Themes and Imagery of Adolescence in Stendhal's *Lucien Leuwen*."
- Waite, Robert Sears (A.B., Duke University). *Physiology and Pharmacology*. Dissertation: "Polyamines in Normal and Hormone-Treated Developing Rat Brain."
- Wallace, Charles Isaac, Jr. (A.B., Bowdoin College; B.D., Yale Divinity School). *Religion*. Dissertation: "Religion and Society in Eighteenth Century England: Geographic, Demographic, and Occupational Patterns of Dissent in the West Riding of Yorkshire, 1715-1801."
- Walther, Philip John (B.S., Michigan State University). *Biochemistry*. Dissertation: "The Activation of Human Plasminogen by Urokinase: A Two-Stage Mechanism."
- Weaver, John Denny (A.B., Goshen College; M.Div., Goshen Biblical Seminary). *Religion*. Dissertation: "The Doctrines of God, Spirit, and the Work in Early Anabaptist Theology 1522-1530: A Comparative Study in the Swiss and South German Lines of Anabaptism."
- White, Carolyn West (A.B., University of North Carolina; A.M., Duke University). *History*. Dissertation: "The Historiography of the Edwardian Era."
- Whittington, Frank Joseph (A.B., Mississippi State University). *Sociology*. Dissertation: "Black Socioeconomic Assimilation: An Analysis of the Effects of Age, Period and Cohort."
- Williams, Ned Irving (B.S., Howard University). *Biochemistry*. Dissertation: "Heterogeneity in Central Nervous System Myelin."
- Williamsen, Thomas Marvin (B.S., Colorado State University). *History*. Dissertation: "Political Training and Work at the Whampoa Military Academy Prior to the Northern Expedition."
- Wilson, Virginia S. (A.B., M.A.T., Duke University). *Education*. Dissertation: "Harold Rugg's Social and Educational Philosophy as Reflected in His Textbook Series, 'Man and His Changing Society.'"
- Winge, Dennis Robert (A.B., Concordia College). *Biochemistry*. Dissertation: "Metal Induced Formation of Metal-Binding Proteins: Characterization of Metallothionein and Metallochelatin."
- Zarzecki, Peter (B.S., University of Miami). *Physiology and Pharmacology*. Dissertation: "Microiontophoretic and Electrophysiologic Studies of the Nigro-Neostriate Pathway in Normal and in Haloperidol-Treated Cats."

## ADVANCED DEGREES CONFERRED SEPTEMBER 1, 1974

### Master of Arts

Anderson, Gilbert Eddy	Iyengar, Nuggehalli	Reilly, John Daniel
Arnett, Douglas O'Neil	KrihnamurthyNarasimha	Roberts, Thomas Naus
Banta, Robert Edward	Johnson, Linnea Marie	Robinson, Susan Porter
Bennett, Laura Anderson	Kraus, Nancy Weigle	Roch, Joseph Benoit
Briscoe, L. Joyce Malone	Lewis, Robert Edward	Roser, Charles Edmund
Clubbe, Susan Allen	Madsen, Stirling Kent	Rubert, Lao Elisea
Da Silva, Delso Morais	Melton, Robert Woods	Schachter, Phyllis Gail
Da Silva, Lea Melo	Moore, Robert Edward	Sharp, Mark E.
Dunbar, James Yarborough, Jr.	Mycock, Damon Joseph	Smith, Sarah Stanbury
Earl, Nancy Lorraine	Nelms, Rhonda Vail Wilcox	Stiff, Lee Vernon
Eckert, Thomas Earle	Ogunsola, Olaogun Oyekola	Tarullo, Daniel Kenneth
Erickson, Ray Josef	Olson, Robert Bernard	Tate, Priscilla Lillian
Faucette, Nathalie Viola Ann	Packer, Roberta Laurie	Testerman, Kay Dianne
Gardner, John Mull	Phillips, Paula Ruth	Todd, Mark Douglas
Geller, Barbara H.	Plyler, Louisa Banks	Wales, Stephen Charles
Graham, Peter William	Pretty, Donna Richter	Ward, Susan Page
Harambe, David Louis	Puzak, John Carl	Whalen, Michelle Vera
	Ramsey, Charles Wesley, III	

### Master of Arts in Teaching

Allen, Roger Frederick	Hester, Sandra Phillips	Sonntag, Marjorie Lynn
Anderson, Craig Lambert	Heubert, Jay Philip	Spruill, Marjorie Julian
Baier, Steven Bradley	Kramer, Deborah Ann	Stevens, David Colby
Barnes, Richard Dallas	Larson, Ray Robert	Stokes, Curtis Clarence
Baumann, Stephen B.	Lentz, Joyce Ann	Sturrock, Alan
Beasley, Victoria Elizabeth	Lindahl, Mary Ann	Sutton, Susan Willey
Bebensee, Elisabeth Lord	Marcus, Donn Stephen	Tapon, Janet Claire
Bingham, Margaret Alice Hamlet	Martin, Donald Lee, Jr.	Thorn, John Baker, Jr.
Bonhage, Mary Theresa	McLean, Norbert Black	Vogel, Erika J.
Burke, Robert Michael	Nickerson, Yvonne Bruist	Ward, James Bradford
Clarke, Paul Graham	Noonan, Richard Bernard	Watson, George Benedict, Jr.
Compton, Helen L.	Ramey, Ray Lewis	Weatherly, John Armfield
Cook, Sandra Joy	Russell, Nancy L.	Webster, Stanley Nelson
Dickens, Deborah Mark	Schwartzman, Steven	Weiss, Edward H., III
Fund, Marsha Gail	Sindelar, Karen Ann	Wimpey, Linda Donaldson
Goldwasser, Lois	Slingerland, Susan Joan	
Hansen, Debera Rose	Smith, Deborah Ellis	

### Master of Education

Beal, Candy Lee Metz	Edson, Mary Alice	O'Cain, Charlotte Rebekah
Blackburn, Mildred Laney	Friedman, Belinda Bundy	Orenstein, Perri Michele
Blaylock, Wilma Frances	Garg, Prabha	Rose, Mary Rogers
Bryan, Sara Beth Jernigan	Gragg, Helon LaDelle Hardin	Sigler, Patricia Gilbert
Casavant, Phyllis Cheryl	Kingrey, Joseph Peter	Swink, Grace Talton
Salisbury	Marcotte, Merry Elizabeth	Thompson, Arthur Shearon
Collins, Nora Shearer	McGehee, Joy Virginia	Weaver, Helen Murray
Cordoni, Barbara Ellen Keene	Milton, Carolyn Tidler	Wentz, Blance August

### Master of Science

Barthelemy, Herve Charles	Ditty, Patrick S.	Stevens, Bradford Lee
Bennetts, Kimberly Robert Winter	Harbridge, William Frank	Stevens, Robert Francis
Boynton, Mary Ellen	Heil, Gregory Harlan	Tokuta, Alade Anthony
Brauer, Constance J.	McCurry, James Reid	Tsentas, Constantine I.
Browning, Robert H.	Paulson, Susan Miller	Vadnais, Paul Alfred
Chapman, Diane A.	Piotrowski, Robert G.	Weber, Eric Edward
Davidson, James Vincent	Rodenhauser, John Francis	Zigenfus, Gary Charles

## Doctor of Education

- Brownell, Richard Lowerison (A.B., George Washington University). *Education*. Dissertation: "State-wide Planning for Public Two-Year College Systems."
- Langley, John Wesley (A.B., Pfeiffer College; M.Ed., University of North Carolina). *Education*. Dissertation: "Due Process and Equal Protection Rights of Secondary Students in Public Schools."
- Pitman, John Carver (A.B., A.M., University of Maine). *Education*. Dissertation: "Training for and Implementation of a Team Approach to Planned Educational Change: An Historical Study."
- Surratt, James Edward (A.B., High Point College; M.Ed., University of North Carolina). *Education*. Dissertation: "A Survey and Analysis of Special Police Services in Large Public School Districts of the United States."

## Doctor of Philosophy

- Andrew, Clifford George (A.B., Columbia College). *Biochemistry*. Dissertation: "Macromolecular Characterization of Muscle Membranes."
- Atalik, Tahsin Selcuk (B.S., M.S., Robert College). *Civil Engineering*. Dissertation: "Stationary Random Response of Nonlinear Multi-Degree-of-Freedom Systems by a Direct Equivalent Linearization Technique."
- Beach, Stephen Wolf (A.B., Stanford University; A.M., Duke University). *Sociology*. Dissertation: "Social Movement Radicalization: A North Irish Case Study."
- Boudreaux, Gregory Raymond (A.B., Louisiana State University). *Philosophy*. Dissertation: "Freud's Theory of Personality and the Concept of Explanation in Psychoanalysis."
- Branch, Betty (A.B., Wake Forest University). *Classical Studies*. Dissertation: "The Development of Script in the Eleventh and Twelfth Century Manuscripts of the Norman Abbey of Fecamp."
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- Higginbotham, Kenneth Orland (B.S., M.S., Utah State University). *Botany*. Dissertation: "The Influence of Canopy Position and the Age of Leaf Tissue on Growth and Photosynthesis in Loblolly Pine."
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- Koenig, Albert August, III (B.S., Loyola College). *Physics*. Dissertation: "Light Scattering in Helium-4 Near the Gas-Liquid Critical Point: The Turbidity and Rayleigh Linewidth."
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- Manton, Kenneth Grant (A.B., Princeton University; A.M., Duke University). *Sociology*. Dissertation: "Some Aspects of the Spatial Organization of Metropolitan Social Systems in the United States and Its Structural and Functional Correlates."
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- Mason, George Alexander (A.B., University of North Carolina). *Anatomy*. Dissertation: "Genetic and Biochemical Studies of Red Cell Acid Phosphatases of Lemurs."
- Menefee, John Alsworth (A.B., Austin College; A.M., North Texas State University). *Economics*. Dissertation: "The Economics of Leisure: The Evolution of the Labor-Leisure Tradeoff in Economic Doctrines."
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- Moore, Josephine K. (A.B., Stetson University; A.M., University of Southwestern Louisiana). *English*. Dissertation: "Swift's Low Humor."
- Morris, Stephen Brent (B.S., Southern Methodist University; A.M., Duke University). *Mathematics*. Dissertation: "Permutations By Cutting and Shuffling—A Generalization to Q-Dimensions."
- Nunez, Walter H. Duran (Professor De Biologia, Universidad Catolica De Chile). *Physiology and Pharmacology*. Dissertation: "Influence of Sympathetic Noradrenergic Nerves on Oxygen Uptake in Mammalian Skeletal Muscle."
- Pedroni, Paul Lester (B.S., Stanford University). *Physics*. Dissertation: "Nuclear Magnetic Resonance Studies of Solid Hydrogen Under High Pressure."

- Rao, M. S. Madhava (B.Sc., Banaras Hindu University; M.E., Indian Institute of Science). *Civil Engineering*. Dissertation: "Plasticity Theory of Fiber-Reinforced Metal Matrix Composites."
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- Sheets, George Archibald (A.B., University of North Carolina). *Classical Studies*. Dissertation: "Problems in Greek Dialectology: A Reinterpretation Based on Structural Theory."
- Smith, Linda Domel (A.B., University of Texas). *Chemistry*. Dissertation: "A Mechanistic Study of the Photoisomerization and Decomposition of Unsymmetric Azo Compounds."
- Steinbach, Wayne Robert (A.B., Lawrence University). *Physics*. Dissertation: "Millimeter and Submillimeter Wave Spectra of the Oxygen Isotopes:  $^{16}\text{O}_2$ ,  $^{18}\text{O}_2$ , and  $^{16}\text{O}^{18}\text{O}$ ."
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- Tapon, Francis (Licence, University of Paris; M.B.A., Columbia University; A.M., Duke University). *Economics*. Dissertation: "Dynamic Investment Model of Regulated Industry: Theoretical and Empirical Study."
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- White, Leland J. (A.B., St. Mary's Seminary & University; S.T.B., S.T.L., Pontificia University; A.M., University of Michigan). *Religion*. Dissertation: "Act in Theology: A Dramatist Inquiry into Method in Karl Barth and Bernard Lonergan."
- Whiting, John Dale, Jr. (B.S., Westminster College). *Biochemistry*. Dissertation: "Multiple Forms of the Blood Group A Substance from Human Erythrocyte Membranes."
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# Index

- Absence, Leave of, 60
- Academic Probation, 59-60
- Academic Regulations, 57-63
- Administration
  - Executive Committee of the Graduate Faculty, vii
  - Graduate School Administration, vii
  - University Administration, vii
- Admission
  - Application Fee, 43
  - Application Deadlines, 45
  - Examinations for, 43-44
  - Foreign Students, Procedures for, 44
  - Nondegree, 44
  - Notification of Status, 44
  - Prerequisites, General, 43
  - Provisional, 44
  - Students Requiring, 43
- Aging and Human Development, Center for the Study of, 15
- Anatomy, 69-73
- Ancient History, 95
- Animal Behavior Station, 30
- Anthropology, 73-77
- Application Procedures, *see* Admission and Student Aid
- Archeology, 95-96
- Art, 77-78
- Asian, Southern, Program in Comparative Studies on, 16
- Asian Languages, 78
- Assistantships: Graduate, Part-time
  - Instruction, Research, 54
- Audit Fee, 48
- Awards, *see* Fellowships, Financial Information, Scholarships, Special Fellowships, and Student Aid
- Biochemistry, 78-81
- Botany, 81-85
  - Laboratories, 29
  - Tropical Biology Program, 23
- Biomedical Engineering, 111-113
- Business Administration, 85-89
- Calendar, iv
- Canadian Studies Program, 15-16
- Chemistry, 89-92
  - Laboratories, 31
- Civil Engineering, 113-118
- Class Size, 60
- Classical Studies, 92-96
- Commencement, 63
- Commonwealth Studies, Center for, 16
- Comparative Literature, 96-97
- Computation Center, 33
- Computer Science 97-100
- Conduct, Standards of, 63-65
- Cooperative Program in Teacher Education, 17
  - see also* Master of Arts in Teaching
- Cooperative Programs with Neighboring Universities, 18
  - Library Exchange, 18
  - Russian and East European History, 18
- Counseling Center, 39
- Course Load
  - For Resident and *in absentia* Doctoral Students, 58
  - For Resident and *in absentia* Master's Students, 58
  - In Summer Session, 58
  - See also* Residence Requirements, Courses of Instruction (departmental and subject listings), 68-212; *see also* Independent Readings
- Credit, Graduate
  - Earned Prior to A.B. Degree, 59
  - Earned under Reciprocal Agreements with Neighboring Universities, 59
  - For Courses Taken in the Law School, 59
  - Transfer of, 1-2, 62
  - See also* Doctor of Philosophy and Master's Degrees (All), Time Limits
- Deadlines
  - Application, 45
  - Dissertation, 12
  - Intention to Graduate, 4
- Cooperative Program in Teacher Education, 17
  - see also* Master of Arts in Teaching
- Cooperative Programs with Neighboring Universities, 18
  - Library Exchange, 18
  - Russian and East European History, 18
- Counseling Center, 39
- Course Load
  - For Resident and *in absentia* Doctoral Students, 58
  - For Resident and *in absentia* Master's Students, 58
  - In Summer Session, 58
  - See also* Residence Requirements, Courses of Instruction (departmental and subject listings), 68-211; *see also* Independent Readings
- Credit, Graduate
  - Earned Prior to A.B. Degree, 59
  - Earned under Reciprocal Agreements with Neighboring Universities, 59
  - For Courses Taken in the Law School, 59
  - Transfer of, 1-2, 62
  - See also* Doctor of Philosophy and Master's Degrees (All), Time Limits
- Deadlines
  - Application, 45
  - Dissertation, 12
  - Intention to Graduate, 4
  - Passing Foreign Language Requirement, 8
  - Passing Preliminary Examination, 10
  - Thesis, 2
- Debts, 49
- Degree Requirements, *see* Individual Degree listings
- Degrees Offered, 1-13
- Demographic Studies, Center for, 18
- Dissertation, *see* Relevant Doctoral Degree
- Dissertation Expenses, 48
- Doctor of Education Degree, Description and Requirements for, 12-13
- Doctor of Philosophy Degree, 7-11
  - Binding fees, 48
  - Committee, Supervisory, 9

- Description, 7-8
- Deposit of Dissertation, 11
- Dissertation, 10-11
- Examinations, Final, 11; Preliminary, 10
- Expenses, Dissertation, 48
- Foreign Language Requirement, 8
- Major and Related Subject Requirements, 9
- Residence Requirements, 9
- Time Limitations, for Completion of, 9-10
- Title, Filing of Dissertation, 10-11
- Duke Forest, 35
- Economics, 100-104
- Education, 105-111
- Electrical Engineering, 118-123
- Engineering, 111-127
  - Biomedical, 111-113
  - Civil, 113-118
  - Electrical, 118-123
  - Laboratories, 34-35
  - Mechanical and Materials Science, 123-127
- English, 127-131
- English for Foreign Students, 63
- Entrance Tests
  - English Tests for Foreign Students, 44
  - ETS Graduate School Foreign Language, 44
  - Graduate Record Examination, 44
- Environmental Center, 19
- Faculty, viii-xiv
- Faculty Ruling, 58
- Fees
  - Athletic, 48
  - Audit, 48
  - Binding, 48
  - Copyright, 48
  - Late Registration, 47
  - Microfilming, 48
  - Motor Vehicle Registration, 48
  - Transcript, 49
  - Undergraduate Courses, 48
- Fellowships
  - Canadian Studies, 52
  - Endowed, 50
  - Federal, 51
  - Graduate, 51
  - James B. Duke, 50
  - Medieval and Renaissance Studies, 52
  - Special Fellowships, 52
  - See also* Financial Information, Scholarships, Special Fellowships, and Student Aid
- Financial Information
  - Audit Fee, 48
  - Binding Fees, 48
  - Assistantships, 54
  - Change of Registration, 57
  - Copyright Fee, 48
  - Debts, 49
  - Expenses, 49
  - Fellowships, 50
  - Food Services, 50
  - Income Tax, 54
  - Late Registration Fee, 57
  - Leave of Absence, 60
  - Living Accommodations, Cost of, 49
  - Loans, 55
  - Motor Vehicle Registration Fee, 48
  - Scholarships, 53-54
  - Teachers, Faculty Spouses, and Other, Special Tuition Rates for, 48
  - Transcript Fee, 49
  - Tuition and Fees, 47-49
  - Undergraduate Course Fee, 48
  - Work Study Program, 55
- Food Services
  - Description of Facilities, 38
  - Estimated Costs, 38, 50
- Foreign Language Examination, 61
  - Waiver of, 61
- Foreign Students
  - Admission, Additional Procedures for, 44
  - English Language Requirements for, 61
  - Insurance, Required, 38
  - Medical Statement, 44
  - Withdrawal or Interruption of Program, 60
- Forestry and Environmental Studies, 131-138
  - Laboratories, 35
- French, *see* Romance Languages
- Gardens, Sarah P. Duke, 29
- Genetics, University Program in, 19
- Geology, 139-141
- Germanic Languages and Literature, 142-143
- Grades, 59-60
- Graduate Fellowships, 50
- Graduate Record Examination, 44
- Graduate Student Association, 40
- Graduate Women's Club, 40
- Greek, *see* Classical Studies
- Health Administration, 143-145
- Health Program for Students, 38-39
- Hindi-Urdu, 78
- Hispanic Studies Program, 20
- History, 145-150
- Housing, 37-38
- Immunology, *see* Microbiology and Immunology
- Institute of Policy Sciences and Public Affairs, 21
- Instructional Staff
  - Emeritus Professors, xix
  - Faculty Members, viii-xviii
  - See also* Courses of Instruction
- Insurance, 38-39
- Italian, *see* Romance Languages
- Judicial Code, 63-65
- Laboratories
  - Animal Behavior Station, 30
  - Botanical and Zoological, 29
  - Chemistry, 31
  - Computation Center, 33
  - Duke Forest, 35
  - Engineering Research, 34-35
  - Forestry Sciences, 35
  - Marine, 30
  - Medical Sciences, Nanaline H. Duke, 32
  - Physics, 30
  - Phytotron, 29
  - Primate Facility, 30
  - Psychology, 32
- Language Requirements
  - Acceptable Languages, 61
  - Foreign Students, 63
  - Special Reading Courses for, 63
  - Undergraduate Courses, 63



Latin, *see* Classical Studies  
 Libraries, 27-29  
     Holdings, 27  
     Special Collections, 27-28  
 Living Accommodations  
     Cost of, 49  
     Deposit for Reservation of, 49  
     Description of, 37-38  
 Loans, 55; *see also* Financial Information  
 Marine Laboratory, 30; *see also* Botany,  
     Chemistry, Zoology, and the University  
     Program in Marine Sciences  
 Marine Sciences, University Program  
     in, 150-153  
 Master of Arts Degree  
     Examining Committee and Examination, 4  
     Filing Intention to Graduate, 4  
     Language Requirements, 5  
     Major and Related Subject Requirements, 3  
     Non-Thesis Option for Completion of  
     Program, 3  
     Prerequisites, 2  
     Thesis, 3  
 Master of Arts in Teaching Degree  
     Committee, 7  
     Cooperative Program in Teacher  
     Education, 17  
     Prerequisites, 6  
     Programs for Degree, 6  
     Recommendation for Teacher  
     Certification, 2  
 Master of Education Degree, Description  
     and Requirements for, 6  
 Master of Health Administration Degree,  
     Description and Requirements for, 7  
 Master of Science Degree  
     Degree Requirements, 5  
     Language Requirement, 5  
     Prerequisites, 5  
     Thesis and Examination, 5  
 Master's Degrees (All)  
     Candidacy Requirements, 1-7  
     Residence Requirements, 1  
     Time Limits for Completion of, 2  
     Transfer of Graduate Credit, 1  
     *See also* individual degree listings  
 Mathematics 153-158  
 M.D.-Ph.D. Programs, 20  
 Mechanical Engineering and Materials  
     Science, 123-127  
 Medical Historian Training Program, 21  
 Medical Scientist Training Program, 20  
 Medical Care, 38-39  
 Medieval and Renaissance Studies, Program  
     in, 23; 158-160  
 Microbiology and Immunology, 160-162  
 Motor Vehicle Registration, 48  
 Nervous System, Predoctoral Training  
     Program in Sciences Related to the, 25  
 Nondegree Admission, 44  
 Oak Ridge Institute of Nuclear Studies, 22  
 Organization for Tropical Studies, 23  
 Pathology, 163-165  
 Pharmacology, *see* Physiology and  
     Pharmacology  
 Philosophy, 165-167  
 Physical Therapy, 167-169  
 Physics, 169-172  
     Laboratories, 30  
 Physiology and Pharmacology, 172-177  
 Phytotron, 29  
 Placement Services, 39  
 Political Science, 177-183  
 Press, Duke University, 41  
 Primate Facility, 30  
 Program Information, 1-13  
 Provisional Admission, 44  
 Psychology, 183-187  
     Laboratories, 32  
 Public Policy Sciences, 187-190  
 Reciprocal Agreements with Neighboring  
     Universities, 59  
 Refund  
     Tuition, 47-48  
     Housing, 49  
 Registration  
     Change of, 57  
     *In Absentia*, 58  
     Late, 57  
     Periods, 57  
     Reciprocal Agreements with Neighboring  
     Universities, 59  
     *See also* Calendar, Course Load  
 Related Fields, *see* Relevant Degree Program  
 Religion, 190-197  
 Research and Publications  
     Duke University Press, 41  
 Residence Requirements  
     Academic Regulations, 57-63  
     Doctor of Philosophy, 9  
     Master's Candidates in Summer Study  
     Only, 1, 67  
     Masters Candidates, General, 1  
     *See also* Course Load  
 Romance Languages, 197-201  
     French, 198-199  
     Italian, 199-200  
 Russian and East European History,  
     Cooperative Program in, 18  
 Scholarships, *see* Fellowships, Financial  
     Information, Special Fellowships, and  
     Student Aid  
 Slavic Languages and Literatures, 201-202  
 Social Systems Simulation Program, 24  
 Sociology, 202-206  
 Southern Studies, Center for, 25  
 Spanish, *see* Romance Languages  
 Special Fellowships  
     Cokesbury Graduate Awards in College  
     Teaching, 52  
     Exchange Fellowships with the Free  
     University of Berlin, 53  
 Shell Fellowships (in African Studies), 52  
     *See also* Fellowships  
 Student Affairs, 40  
 Student Aid  
     Payment of Stipends, 54  
     Types Available, 50-55  
     *See also* Financial Information and Loans  
 Summer Session  
     Description, 67  
     Regulations Governing, 67

Teacher Certification, 2  
 Teacher Education, Cooperative Program  
     in, 17  
 Thesis  
     Expenses, 48  
     *See also* Relevant Master's Degree  
 Transfer of Graduate Credit, 1, 59  
 Tuition and Fees  
     Adjustment with Change in Registration, 57  
     Audit Fee, 48  
     Dissertation Fees, 48  
     Estimates, Table of, 50  
 Special Fees for Teachers, Faculty Spouses,  
     and Others, 48  
     Stipends and Income Tax, 54  
 Transcript Fee, 49  
 Undergraduates  
     Courses Primarily for, 60  
     Duke Students, Graduate Credit for, 59  
 Visiting Scholars, 41  
 Withdrawal or Interruption of Program  
     From Course, 60  
     From the Graduate School, 60  
 Zoology, 206-210  
     Laboratories, 29  
     Tropical Biology Program, 23,

# MAP OF DUKE UNIVERSITY

## East Campus

- |   |                         |    |                      |
|---|-------------------------|----|----------------------|
| A | Baldwin Auditorium      | O  | Pegram House         |
| B | Bassett House           | P  | Duke Press           |
| C | Brown House             | Q  | Infirmary            |
| D | Union Building          | R  | Ark                  |
| E | Faculty Apartments      | S  | Crowell Building     |
| F | Art Museum, Geology     | T  | Epworth Inn          |
| G | Aycock House            | U  | Gilbert-Addams House |
| H | East Duke Building      | W  | Campus Center        |
| I | West Duke Building      | X  | Woman's College      |
| J | Jarvis House            |    | Gymnasium            |
| K | Carr Building           | Y  | Asbury Building      |
| L | Giles House             | Z  | Bivins Building      |
| M | Woman's College Library | AA | Art Building         |
| N | Alspaugh House          | BB | Branson Building     |



## West Campus

- |   |                                     |   |                                       |   |                    |    |  |
|---|-------------------------------------|---|---------------------------------------|---|--------------------|----|--|
| A | Duke Chapel                         | H | Hospital Main Entrance                | O | Graven Quadrangle  | V  | Card Gymnasium                             |
| B | Divinity School                     | I | Gerontology, D & T, Clinical Research | P | Wannamaker Hall    | W  | Indoor Stadium                             |
| C | Gray Building                       | J | Duke Hospital                         | Q | Crowell Quadrangle | X  | School of Law                              |
| D | Perkins Library                     | K | Sociology, Psychology                 | R | Clock Tower Court  | Y  | Gross Chemical Laboratory                  |
| E | Language Center                     | L | Social Sciences                       | S | Kilgo Quadrangle   | Z  | Biological Sciences                        |
| F | Did Chemistry Building              | M | Allen Building                        | T | Union Building     | AA | Plant Environment Laboratory               |
| G | Davison Building School of Medicine | N | Few Quadrangle                        | U | Flowers Building   | BB | Physics Building                           |
|   |                                     |   |                                       |   | Page Auditorium    | CC | Nuclear Laboratory                         |
|   |                                     |   |                                       |   |                    | DD | School of Engineering                      |
|   |                                     |   |                                       |   |                    | EE | Army Research                              |
|   |                                     |   |                                       |   |                    | FF | Medical Center Research Buildings          |
|   |                                     |   |                                       |   |                    | GG | Nanahine H. Duke Medical Sciences Building |
|   |                                     |   |                                       |   |                    | HH | Warehouse, Shop                            |
|   |                                     |   |                                       |   |                    | II | Bell Building                              |
|   |                                     |   |                                       |   |                    | JJ | Hanes House                                |
|   |                                     |   |                                       |   |                    | KK | School of Nursing                          |
|   |                                     |   |                                       |   |                    | LL | Hanes House Annex                          |
|   |                                     |   |                                       |   |                    | MM | Pickens Rehabilitation Center              |
|   |                                     |   |                                       |   |                    | NN | Graduate Center                            |
|   |                                     |   |                                       |   |                    | DD | Alumni House                               |
|   |                                     |   |                                       |   |                    | DD | Commonwealth Studies Center                |
|   |                                     |   |                                       |   |                    | PP | Personnel Office                           |
|   |                                     |   |                                       |   |                    | QQ | International House                        |
|   |                                     |   |                                       |   |                    | RR | Personnel Office                           |
|   |                                     |   |                                       |   |                    | SS | Education Improvement Program              |
|   |                                     |   |                                       |   |                    | TT | A Better Chance Program                    |
|   |                                     |   |                                       |   |                    | TT | International Studies Center               |
|   |                                     |   |                                       |   |                    | UU | Campus Stores Office                       |
|   |                                     |   |                                       |   |                    | VV | Office of Institutional Advancement        |
|   |                                     |   |                                       |   |                    | WW | Information Services                       |
|   |                                     |   |                                       |   |                    | XX | Visitors Bureau                            |
|   |                                     |   |                                       |   |                    | YY | Admissions Office                          |
|   |                                     |   |                                       |   |                    | ZZ | Edens Quadrangle                           |
|   |                                     |   |                                       |   |                    |    | Wade Stadium                               |













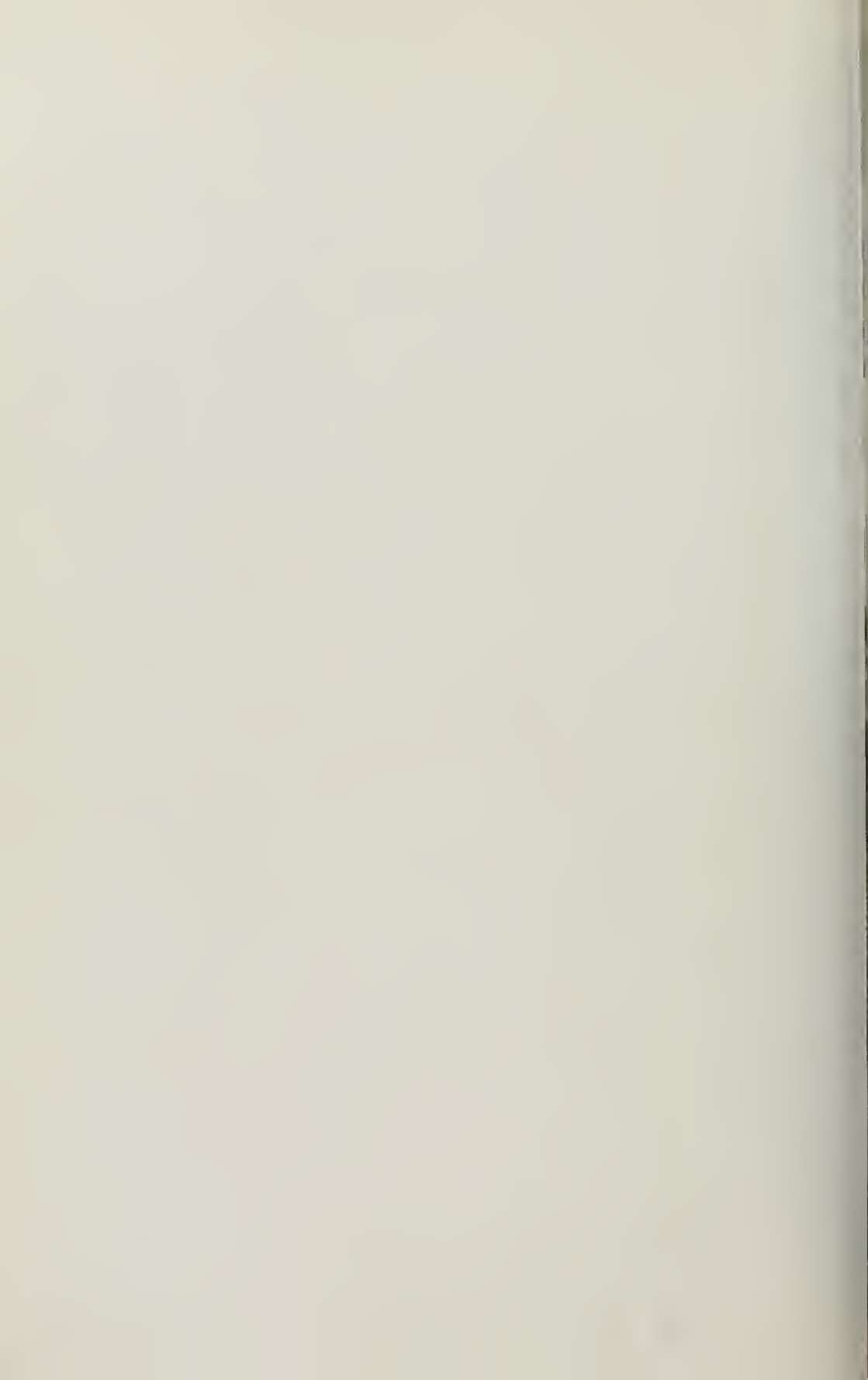










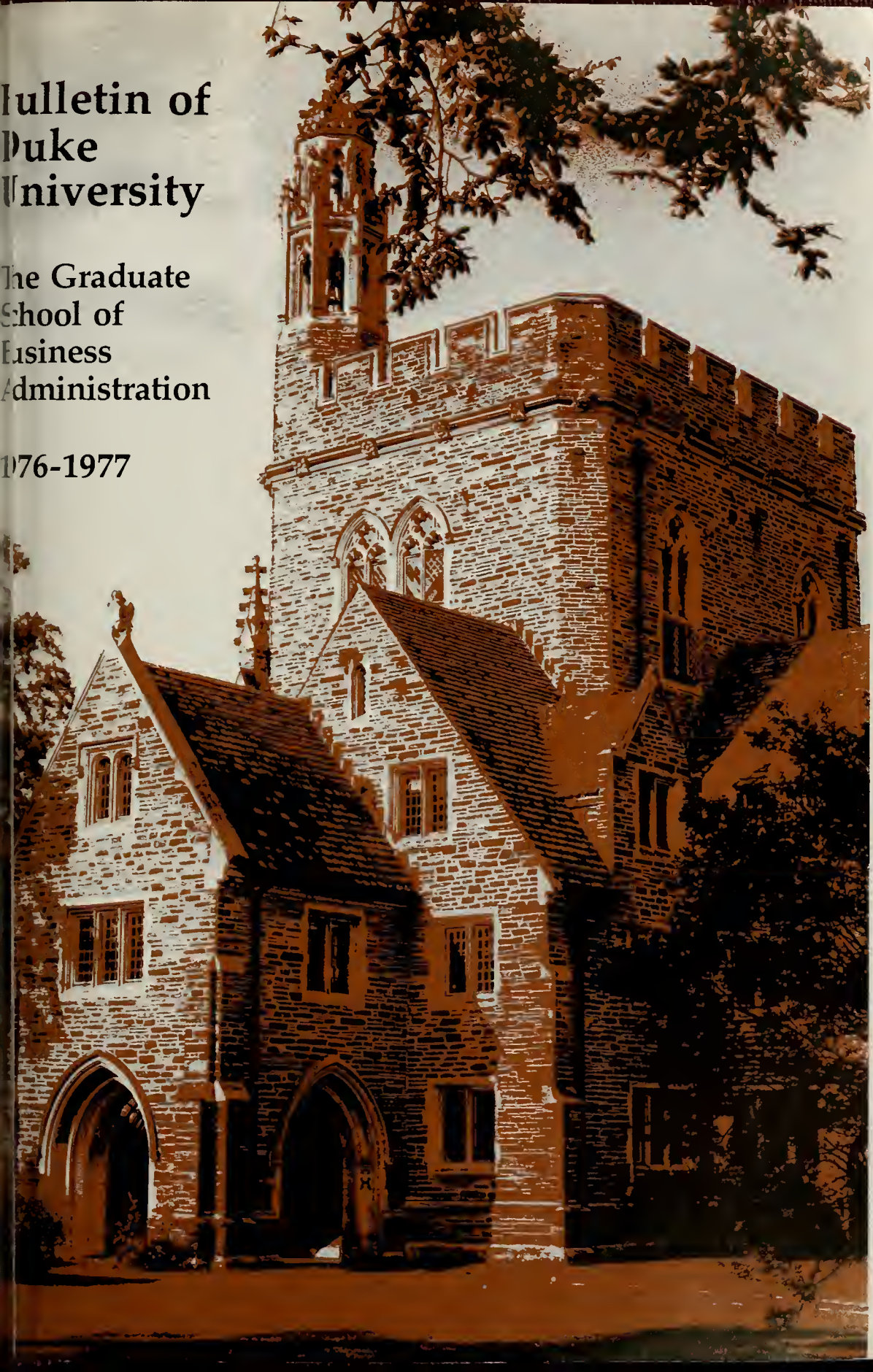




# Bulletin of Duke University

The Graduate  
School of  
Business  
Administration

1976-1977





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The Graduate School of  
Business Administration

1976-1977



Durham, North Carolina 1975

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson  
Duke University Bulletins Office

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PHOTOGRAPHS  
Elizabeth Matheson

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## **Contents**

<b>Officers of the Administration</b>	iv
<b>Calendar</b>	iv
<b>Board of Visitors</b>	v
<b>General Information</b>	vi
The University	1
Resources of the University	2
<b>Programs</b>	4
The Master of Business Administration	5
The Master of Science in Management	7
The Doctor of Philosophy	8
The M.B.A.-J.D.	9
Executive Development Programs	9
<b>Admissions</b>	10
<b>Financial Information</b>	14
<b>Student Life</b>	18
<b>Courses of Instruction</b>	24
Master of Business Administration	25
Master of Science in Management	29
Doctor of Philosophy	30
<b>Faculty</b>	32
Appendix	42

# Officers of the Administration

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Joseph Battle, Ph.D., *Director of the Master of Business Administration Program*  
Kenneth R. Baker, Ph.D., *Director of the Master of Science in Management Program*  
David W. Peterson, Ph.D., *Director of the Doctor of Philosophy Program*  
Sally Sethness, B.A., *Assistant Director of Student Services*

## Calendar Graduate School of Business Administration

1976		1977	
August		January	
31	Registration	10	Classes begin
September		March	
7	Classes begin	7	Spring vacation begins
		14	Classes resume
November		April	
24	Thanksgiving recess begins	22	Last day of classes
29	Classes resume	25-29	Final examinations
December		May	
10	Last day of classes	8	Commencement
13-17	Final examinations		

# Graduate School of Business Administration Board of Visitors

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C. West Churchman, *Professor of Business Administration*, University of California at Berkeley  
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M. H. Winger, Jr., *President*, American Enka Company



## General Information





## The University

With the establishment of the James B. Duke Indenture of Trust of 1924, Trinity College, a small, church-supported school, became Duke University. In the years since 1924, Duke's enrollment has grown to about 8,500 of whom 2,750 are enrolled in graduate-professional programs. The student body represents nearly every state and sixty foreign countries. The University is a member of the North Carolina and Southern Associations of Colleges and Schools and of the Association of American Universities.

As the University developed around the core of undergraduate colleges and schools, its graduate school expanded in areas of instruction and research. Professional education is offered in Schools of Medicine, Nursing, Law, Engineering, Forestry, Divinity, and Business Administration. The establishment of the Graduate School of Business Administration was in keeping with the objectives of all Duke professional schools: to prepare qualified individuals for professional leadership and to develop excellence in education for the professions. By building on the existing set of resources and past experience, a program of high quality for graduate education in business administration was founded.

**The Campus.** The Duke campus is located in Durham, North Carolina, a city with a population of about 102,000 near the center of the state. Duke is an integral part of the growing Research Triangle of the Piedmont section of North Carolina. The Triangle, an education-research complex, utilizes the resources of the several universities in Durham, Raleigh, and Chapel Hill. Interstate 85 runs north of the campus, providing easy access to Greensboro, Raleigh, Chapel Hill and points beyond. Skiing, boating, hiking, camping, and other outdoor recreational activities are within a few hours drive to the mountains or the beaches. The climate in Durham is moderately cold in winter and hot in summer.

The Duke campus is divided in two parts: West Campus, dominated by Gothic architecture and the magnificent Duke Chapel, and the red-brick Georgian-style East Campus. Free bus service connects the two campuses.

The Graduate School of Business Administration is housed on the main quadrangle of Duke's West Campus in the Social Sciences Building. This building is directly opposite the William R. Perkins Library and next to the Allen Building (central administration offices). Classrooms, computer terminals, and faculty offices of the Graduate School of Business Administration are all contained within the Social Sciences Building.

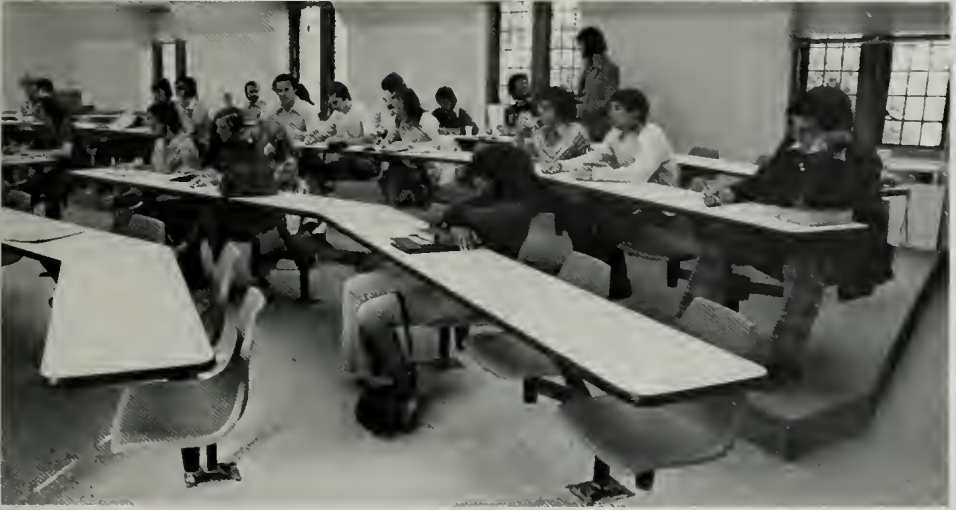
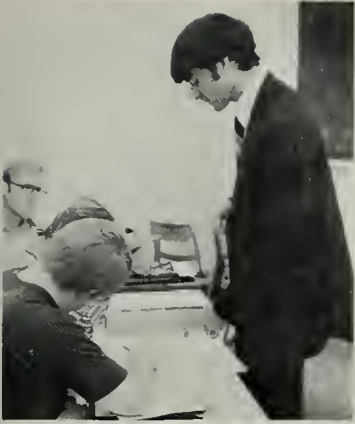


## Resources of the University

**The Library.** The William R. Perkins Library is located opposite the Graduate School of Business Administration. The G.S.B.A. Reading Room and most of the collections from the basic disciplines related to management are in the Perkins Library. In addition to the two-million volume collection available there, students have access to Duke's Law and Engineering Libraries.

**Computing Facilities.** The Duke University Computation Center is intended to provide the University faculty and students with a facility for research and instruction in computing. The center is presently equipped with an IBM 370 Model 135 which is connected by high-speed lines to an IBM 370 Model 165 located at the Triangle Universities Computation Center in the Research Triangle Park. Of special interest to students in the M.B.A. program are a medium-speed card reader and line printer located adjacent to the Business School, and the slow-speed terminals for inter-active computing, located in the Business School. These are the terminals most used by M.B.A. degree candidates for access to the Model 165.

**Office of Placement Services.** Duke University maintains an Office of Place-



ment Services which acts as a liaison between the University and potential employers in business and industry, education, and government. All services are offered without charge to Duke students and alumni. The staff is available to talk with graduate students about their future professional plans. Graduate students who wish to register with the office are offered an opportunity to assemble a complete dossier of academic records and recommendations to supplement applications for positions, and to have a permanent file for future reference. Pertinent recommendations should be accumulated while a student is enrolled at Duke. Interviews with representatives visiting Duke are scheduled throughout the year for students registered with the Office of Placement Services.

**The Duke University Counseling Center.** Through the Counseling Center, the University provides a professional counseling service designed to aid students in gaining a better understanding of themselves and the opportunities available to them. Counseling is available in the areas of career planning, educational opportunities, and personal and social adjustment.

The center maintains files of educational and vocational information related to career planning, graduate educational programs and fellowships, and study aids.

National and University-wide testing programs are administered by the center. The staff conducts continuing research in counseling and testing.





## Programs





Most students completing graduate work in business administration in the last half of the seventies will begin careers that will span several decades. We envision this period to be one of rapid and radical change. We are of the opinion that an educational program designed to study present-day business problems and approaches to their solution is not adequate. The problems which organizations will face are unpredictable, and the solution techniques which will be available may be unknown at the present time. Our graduate programs are, therefore, designed to help the student develop a base from which he continues to learn. Our programs stress concepts and analytical reasoning while providing the student with a knowledge of the current status of business practice and decision models which are used by managers in leading organizations.

The Master of Business Administration program is designed for persons desiring to embark upon a career in management who can devote full time to their education for two academic years. The Master of Science in Management is designed for persons who concurrently hold a position in management and who wish more formal education. This program requires part-time study for two complete calendar years. The Doctor of Philosophy program is designed primarily for those persons desiring a career in research and teaching in the field of business administration. The Ph.D. degree requires a minimum of three years for persons who enter the program without prior graduate study.

## **The Master of Business Administration**

The Duke M.B.A. degree is designed to meet the challenges of rapid change in our society through emphasis on concepts and analytical reasoning. The student is continually asked to structure unstructured situations and to propose solutions to complex problems. To provide a basis for this approach to learning, the first year of the program is devoted to developing a working knowledge of economic principles, principles of organization and behavior, accounting systems, and quantitative methods for the solution of management problems.

The particular focus on concepts and theory produces special qualities in the Duke M.B.A. candidate. By studying managerial theory and economic principles, the student acquires the capability of assuming responsibility in a wide variety of specific assignments within any organization. By studying the problem of economic enterprise in an integrated fashion, he acquires the capa-

bility of viewing decision-making from the perspective of the entire organization rather than from the narrow viewpoint of a single function or discipline. By studying the strategy of the firm, he acquires the capability of contributing effectively to the strategic planning process in an organization and to the implementation of its plans. By studying analytical tools and problem structures, he acquires the capability of identifying the common form of problems that in many respects appear to be different and to grasp quickly the essential nature of new problems with which he has limited experience.

**Outline of the Curriculum.** The M.B.A. degree requires four semesters of full-time work, totaling 64 semester-hours of graduate course credit. On rare occasions students who have prepared themselves in a particular subject beyond the standard level upon entering will be allowed to substitute more advanced work for one or more of the core courses. In the summer between the first and second years, the M.B.A. student is expected to gain practical experience through related employment. Aside from its obvious financial benefits, this experience should aid the student in his selection of second year electives, possibly including the practicum. In many cases, the student electing the practicum will select his topic and begin work on it during the summer.

**First Year Program.** Course work for the first year of the M.B.A. program provides the basic knowledge required to understand and to analyze the operations of an organization. The topics are arranged to reinforce knowledge gained in one course by applying that knowledge in other courses. This sequencing also permits basic assumptions, developed in a tight, theoretical structure in one area to be related and examined in subsequent work in other areas.

The courses are organized to permit specific problems from the functional areas of marketing, production, finance, and personnel to be examined in terms of the more general concepts under consideration. The subject matter of the separate courses is coordinated to help the student understand the interrelated aspects of the functions within the organization.

The first year program includes:

#### First Semester

BA 300	Managerial Economics I	5 units
BA 310	Mathematics for Management	5 units
BA 320	Organization Theory and Management I	3 units
BA 330	Accounting Systems I	3 units
		<u>16 units</u>

#### Second Semester

BA 301	Managerial Economics II	3 units
BA 311	Statistical Analysis for Management Decisions	4 units
BA 312	Operations Research	3 units
BA 321	Organization Theory and Management II	3 units
BA 331	Accounting Systems II	3 units
		<u>16 units</u>

**Second Year Program.** The third semester is designed to permit an in-depth study of the functional areas of the organization. The study of information systems facilitates the understanding of the interrelationships that exist among these functions. The work of this semester is structured to help the student observe specific needs for information at the same time he is studying the general subject. Strategic planning is developed during the semester with the

aid of a business game. The game allows the student to analyze the decisions required within a single function and to study the impact of a single decision on the entire firm. During this semester the study of external influences on the firm continues with a course on its legal environment. The required courses are:

**Third Semester**

BA 335	Management Information and Control Systems	3 units
BA 345	Legal Environment of the Firm	2 units
BA 355	Financial Strategy	3 units
BA 365	Market Strategy	3 units
BA 375	Operations Strategy	3 units
BA 385	Strategy of the Organization I	2 units
		<u>16 units</u>

In the fourth semester the focus of the student’s study is again on strategic planning and also on issues of public policy. The three electives in the fourth semester permit the student to select an area for more concentrated study. At this point, the skills acquired in the previous three semesters are brought to bear on particular problem areas, as the student works toward applying his knowledge to problems that organizations currently face. The courses are:

**Fourth Semester**

BA 346	Public Policy of the Firm	3 units
BA 386	Strategy of the Organization II	4 units
	Electives	9 units
		<u>16 units</u>

**The Master of Science in Management**

For some students, combining graduate study with work experience provides more effective professional development than full-time study. The Duke Master of Science in Management degree program serves this need by offering a sound education in Management, and, at the same time, allowing the student to continue in a managerial or administrative position.

The Master of Science in Management program contributes to the development of promising managers as they attempt to improve the performance of the organizations in which they work. More specifically, the M.S.M. program is designed to teach the principles and the tools of managing an economic enterprise.

The M.S.M. program begins with a set of core courses in which the student acquires the tools of economic analysis, learning to view the firm as an economic entity, to analyze the firm in terms of its components, and to recognize the influences of the larger environment in which the firm exists. These basic concepts lay the foundation for the construction and application of useful economic models in several arenas, enabling the student to contribute to the solution of a variety of problems in his firm.

The program continues with an examination of the typical problems of economic enterprise, introducing the student to the functional areas of the firm and describing contemporary managerial practice. The student is taught to recognize the relationships among the specialized functional areas and to apply economic analysis to the solution of typical management problems.

The program culminates in a series of elective courses in which the student refines his knowledge and skills by studying one or more management disciplines in further detail.



This education in management—emphasizing economic principles and problem-solving tools—improves the manager’s ability to learn from events in his working environment, to view decision-making from an integrated perspective, and thus to provide effective leadership in a management role.

Completion of the program usually requires twenty-four months of study, with classes scheduled Monday and Thursday each week from 5:00 to 9:00 p.m. Additional information about admissions and curriculum is available on request. The courses required in the program are listed below:

### Courses Required

MS 300	Managerial Economics	4 units
MS 318	Calculus for Management	2 units
MS 310	Quantitative Methods	4 units
MS 311	Statistics	4 units
MS 312	Operations Research	4 units
MS 320	Organization Analysis and Design	4 units
MS 330	Accounting and Control Systems	4 units
MS 341	External Environment of the Firm	4 units
MS 380	Planning and Control Problems of the Firm	8 units
	Electives	12 units
		<u>50 units</u>

## The Doctor of Philosophy

The purpose of the Ph.D. program is to prepare candidates for research and teaching careers at leading educational, governmental, and corporate institutions. Students are encouraged to participate in the research activities of the faculty and other students through seminars and special projects.

**Course Requirements.** The program accepts students with a bachelor’s degree and usually lasts three to four years. Prerequisites for the program include a one-year course in calculus, one course in linear algebra, and proficiency in a scientific computing language. The specific program of study is determined by the student and his faculty adviser, subject to the approval of the Director of the Doctoral Program. Generally, the first three semesters of study closely parallel those in the M.B.A. program. They serve to impart an



integrated viewpoint of the marketing, financial, operational, and informational aspects of organization management based on rigorous foundations in economic theory, organization theory, accounting, optimization theory, and mathematical statistics. Subsequent study is devoted to developing knowledge of the research literature in each of two areas related to management. The extent of this knowledge should permit the student to begin contributing to that literature. This concentration requirement is usually satisfied in an area when a student completes two elective courses in that area beyond those courses offered in the first three semesters of the Ph.D. program. Areas of concentration are usually closely related to dissertation work and may be effected through courses offered on a tutorial basis.

**Preliminary Examinations.** Economics theory, quantitative methods, and an elected field of administration are the areas covered by the preliminary examinations. Usually, these examinations are taken upon completion of the formal course requirements, at about the same time that work on the dissertation is beginning. These examinations are intended to provide evidence of the student's depth of understanding in the above areas and of his capability to complete the Ph.D. program.

**Doctoral Dissertation.** The doctoral dissertation is expected to be original research in some area of theory, analytic methods, or administrative application related to improvement of the performance of economic organizations. The main purpose of the dissertation should be to contribute to knowledge pertinent to the management of organizations.

**Final Examination.** The final examination is conducted orally and usually dwells primarily on dissertation-related matters.

## **The M.B.A.-J.D.**

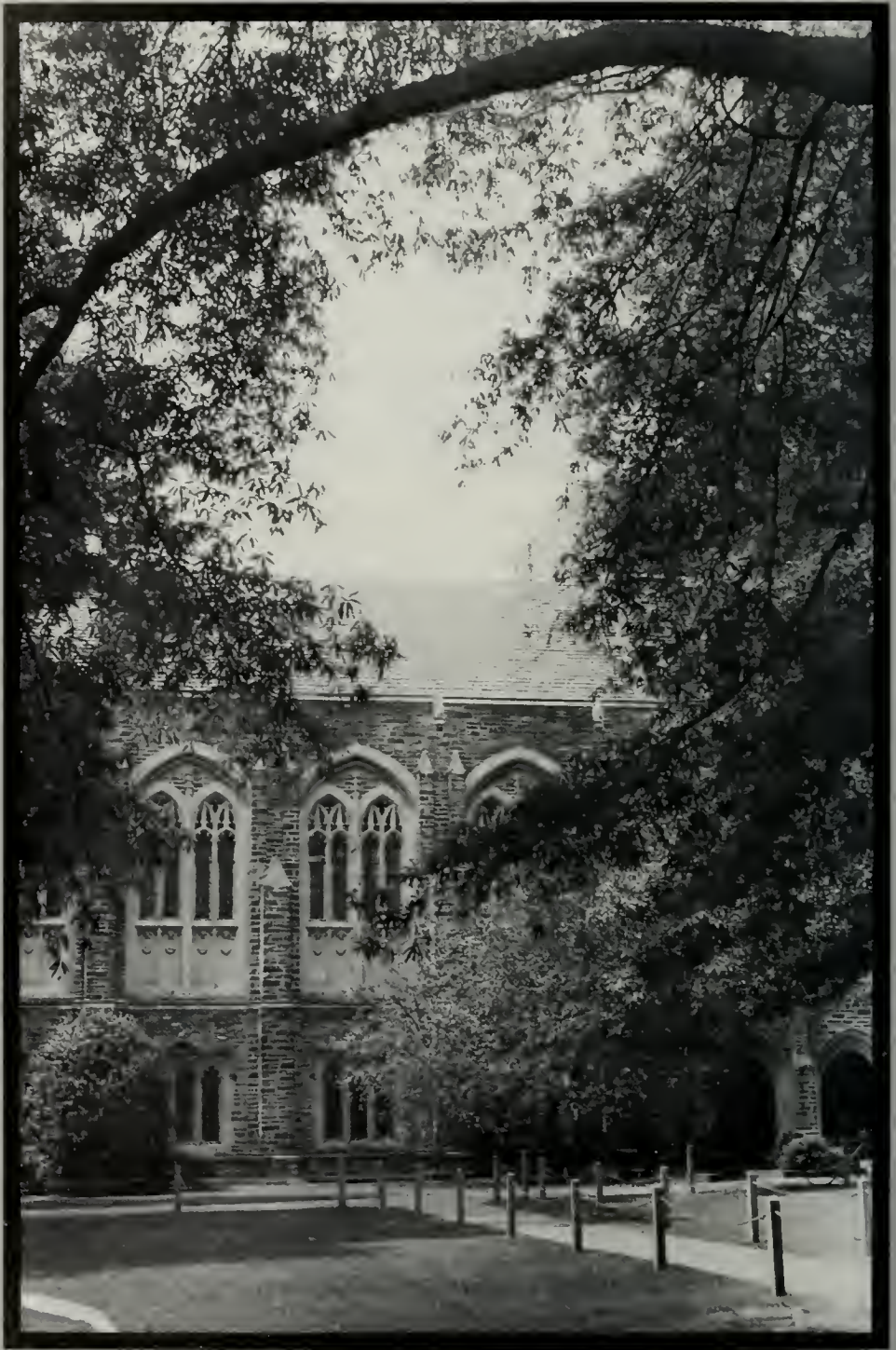
The School of Law and the Graduate School of Business Administration offer a combined M.B.A. and J.D. program that can be completed in four academic years. The first two years are allocated to a full year in each program in either sequence. The latter two years are devoted to an integrated program that meets the requirements for completion of both the M.B.A. and J.D. degrees. Both degrees are awarded upon successful completion of the combined program.

To apply for admission to this program, students must submit applications for both the M.B.A. and J.D. programs. Additional information about the program and application procedures may be obtained on request from the Director of Admissions, Graduate School of Business Administration.

## **Executive Development Programs**

In addition to the degree programs at the Graduate School of Business Administration, the School offers various Executive Development Programs. These programs are designed to meet the needs of business organizations and their executives. The courses vary in length from a few days to three weeks, and are tailored to the requirements of the participating group. The programs are usually residential, giving participants maximum involvement with each other and with the faculty. Programs in Cash Management, Management Science in Banking, and the Management of Capital Expenditures have been conducted in past years.

Further information on Graduate School of Business Administration Executive Development Programs may be obtained from the Director of Executive Development Programs, Graduate School of Business Administration.



## Admissions



Admission to the Graduate School of Business Administration is open to men and women who hold bachelor's degrees from accredited colleges and universities. No specific undergraduate major is deemed preferable to any other; however, the programs have been designed primarily for persons with training in the liberal arts, engineering, or the sciences. The Admissions Committee seeks those candidates with leadership potential who are prepared to compete successfully in a demanding course of study which requires logical and analytical reasoning.

Prior work experience is not considered a requirement for the M.B.A. or Ph.D. programs. The Admissions Committee does, however, recognize the value of previous experience and considers it a positive factor in admission decisions.

**Application Information.** Each applicant must submit the following to the Director of Admissions before action can be taken:

1. An application.
2. Two transcripts from each undergraduate and graduate school attended. (Final transcripts must also be sent prior to matriculation.)
3. Personal and professional recommendations.
4. Scores on the Graduate Management Admission Test.
5. A nonrefundable \$15.00 application fee.

Any questions or requests for application materials should be addressed to the Director of Admissions, Graduate School of Business Administration, Duke University, Durham, North Carolina 27706.

**Application Deadlines.** A continuous admissions policy is followed in the Graduate School of Business Administration in that admission decisions are made as applications are completed. Generally, applications completed by the first of the month will be reviewed, and a decision is made by the first of the following month. Application credentials should be on file in the School by April 1 and must be completed before action can be taken. Although applications after April 1 are accepted, chances of admission are diminished.



**Admission of Foreign Students.** Fully qualified students from outside the United States are welcome at the Graduate School of Business Administration. They are encouraged to pursue normal degree requirements but may also be admitted for nondegree course work if the length of their stay in the United States does not permit time for the completion of degree requirements. In applying for admission, the foreign student should submit, in addition to the credentials required of all students, the following:

1. If his native language is not English, certification of ability to use English through scores on tests provided by the Educational Testing Service (TOEFL).
2. A statement certified by a responsible person that his finances are sufficient to maintain him during his stay at Duke University. (See the section on Tuition and Other Costs.)
3. A statement by a qualified physician describing the physical and mental health of the applicant.

**Notification of Status.** When the applicant has been accepted, he will be sent a letter of admission and an acceptance form. A nonrefundable tuition deposit of \$50 is required for the M.B.A. and Ph.D. programs, and while \$200 is required for the M.S.M. program. The process of admission is not complete until the statement of acceptance and the tuition deposit have been returned to the Director of Admissions, Graduate School of Business Administration.







**Graduate Management Admission Test.** The Graduate Management Admission Test, required of all applicants, is administered by the Educational Testing Service. Detailed information about the test and application forms may be obtained by writing directly to the Educational Testing Service, Box 966, Princeton, New Jersey 08540.

The examination is administered at many centers throughout the United States and abroad. Arrangements to take the test at an established center must be made two weeks before the test date (six weeks prior to test date at established foreign centers). The examination is given in November, January, March, and July. Special centers may be arranged for persons distant from established centers. Requests for such accommodations must be made at least three weeks prior to the selected test date. Fellowship applicants should take the test in November or January. Other applicants may take it as late as March, but the earlier dates are strongly recommended.



## Financial Information



## Tuition and Other Costs

The following table shows tuition and fees for students in the Graduate School of Business Administration for the year 1976-77. All charges for each semester are payable at times specified by the University for that semester and are subject to change without notice.

Tuition (full semester program of 16 units—M.B.A. and Ph.D. degrees)	\$1600.00
Tuition (full semester program of 8 units—M.S.M. degree)	975.00
Late Registration Fee	25.00
Doctoral Candidate's Fees	
Dissertation Binding Fee (3 copies)	15.00
Dissertation Microfilming Fee	25.00
<i>In Absentia</i> Fee (1 unit per semester)	100.00

After the beginning of classes, no refund of tuition will be made except in the event of death or involuntary withdrawal to enter the armed services; refunds will be made on a pro-rata basis. In all other cases of withdrawal, students or their parents may elect to have tuition charges refunded or carried forward as a credit for later study, according to the following schedule:

1. Withdrawal before classes begin: full refund.
2. Withdrawal during the first or second week of classes: 80 percent.
3. Withdrawal during the third, fourth, or fifth week of classes: 60 percent.
4. Withdrawal during the sixth week: 20 percent.
5. No refunds after the sixth week.
6. Tuition or other charges paid from grants or loans will be restored to those funds, not refunded or carried forward.

**Debts.** No records are released and no student is considered by the faculty as a candidate for graduation until he has settled with the Bursar for all indebtedness.







## Financial Aid

The Graduate School of Business Administration endeavors to make it possible for qualified students from the United States to attend Duke even though their own resources are insufficient. The forms of financial aid range from fellowships and scholarships to various loan programs. Applicants are expected to make use of personal savings, veterans' benefits, summer income, loans from family, and other outside resources prior to requesting aid.

Foreign applicants may apply for fellowships and loans; however, funds designated to these areas are limited and highly competitive.

**Fellowships.** A number of fellowships are available to incoming students. In awarding fellowships, primary emphasis is given to academic excellence, with need taken into consideration as to the amount of the award. Students wishing to apply should file the "Financial Aid Request" form no later than March 1 to receive full consideration. A limited number of awards are reserved for outstanding applicants applying as late as early summer.

Additional fellowships are granted to second-year students based on their performance during the first year of the program.

**Loans.** Students not receiving fellowships or scholarships are encouraged to consider loans to help finance their education. A substantial number of students find that the increased future earning potential makes this form of financing practical.

A limited number of National Direct Student Loans are available for those applicants who qualify on the basis of need. The maximum amount that may be borrowed is \$2500 per year. Interest is charged at the rate of 3 percent per year with repayment beginning nine months after completion of all education.

The Duke University Federally Insured Loan Program allows the student to borrow up to \$2500 per year at 7 percent interest. A student will have a maximum of ten years following graduation or withdrawal from the University to repay the loan. An interest subsidy, while in school, is available from federal funds for students who have demonstrated need.

The Graduate School of Business Administration has a nonsubsidized loan plan with interest rates based on the current cost of bank borrowing. More complete information on this plan is available on request.

**Financial Aid Application.** Financial aid decisions are made as applications are completed, with the first awards being granted about March 1. To be considered for the full range of awards, applicants should complete both admissions and financial aid applications for fellowships and/or loans early.

The Duke Graduate School of Business Administration is a participant in the Graduate and Professional School Financial Aid Service (GAPSFAS). All applicants for financial aid must file a GAPSFAS form entitled "Application for Financial Aid for the Academic Year 1976-77." The GAPSFAS application may also be obtained from the Graduate and Professional School Financial Aid Service, Box 2614, Princeton, New Jersey 08540, and should be filed no later than February 1, in order to ensure its arrival at Duke by March 1. It contains sections to be completed by the applicant, by the spouse or spouse-to-be, and by the applicant's parents. The student must complete the applicant and spouse sections to be considered for aid, fellowship, or loan at the Graduate School of Business Administration at Duke University. Applicants who have been claimed as dependents by their parents in the previous year or who will not be considered "independent" by federal standards must have the Parents' Questionnaire section completed if applying for loans.



## Student Life



## Living Accommodations

Duke University offers varied living accommodations to married and single graduate students. A brief description of each follows:

**Residence Hall Accommodations.** The Graduate Center, located near the Duke Medical Center, houses 149 male graduate and professional school students, 56 women graduate and professional school students, and 119 undergraduate women. Room assignments are made in order of application; students first applying are those first assigned.

The graduate women's section, in the center and south wings of the second floor, and the undergraduate women's section on the third floor, are separated from the men's residential area. Resident counselors advise all occupants and often work in conjunction with a representative house committee.

Single rooms in the men's section are reserved for returning students; other rooms are for double occupancy. Each room is equipped with the following furnishings for each student: bed with innerspring mattress, chest with mirror, desk with chair, and book shelves.

**Town House Apartments.** These apartments are intended primarily for single graduate and professional school students, although married students and families may be housed in individual apartments. All apartments have two bedrooms, air-conditioning, and furnishings for three students.

**Central Campus Apartments.** This complex of 500 units is operated for the entire student community of the University and the Medical Center. An allocation plan is followed so that each segment of the student community is represented in the apartments. Because of this and an expected turnover of about 25 percent annually, not all student applicants may be accommodated at the time they desire.

One-bedroom, two-bedroom, and three-bedroom apartments are open to single students. Apartments for married students include a few furnished efficiencies, and some one-, two-, and three-bedroom units in which the kitchen, living room, and first bedroom is furnished.



**Application Procedure.** The Department of Housing Management provides students accepted to the University with housing application forms and detailed information on rates, rental agreements, and availability of housing. A completed and returned application form, accompanied with the required \$50 residential deposit, will reserve a housing unit.

**Off-Campus Housing.** The Department of Housing Management maintains lists of rental apartments, rooms, and houses provided by Durham property owners or real estate agents who have agreed to rent to students and not to discriminate in renting by race, creed, or nationality. These lists are available only in the Department of Housing Management office. The Manager of Apartments and Property and his staff will assist any member of the Duke community in seeking suitable off-campus housing; however, off-campus rental properties are not inspected or approved, nor does the University or its agents negotiate with owners for students, faculty, or staff.

For additional information, write to: Manager of Apartments and Property, Department of Housing Management, Duke University, Durham, North Carolina 27706.

**Food Services.** Food service on the East Campus is cafeteria style. The dining facilities on the West Campus include one cafeteria with multiple-choice menus, one area which includes cafeteria counters as well as grill, and a table-service dining room, the Oak Room, where full meals and a la carte items are served. The Cambridge Inn, a self-service snack bar also located in the West Campus Union, is open from 9:00 a.m. until 12:30 a.m. each day except Saturday. All types of snack and sandwich items are available there. The Graduate Center has a public cafeteria and a coffee lounge. Because of the large numbers served in the dining halls, it is not possible to arrange special diets for individual students.

The cost of meals approximates \$3 to \$4 per day, depending upon the needs and tastes of the individual.

## Student Affairs

**Office of Student Services.** The purpose of the Office of Student Services is to increase the effectiveness of student administration and non-academic advising. The office is responsible for information about student employment, financial aid policies and programs, and Graduate School of Business Administration alumni communications. Student Services also works with the M.B.A. Student Association coordinating other student activities and needs.

**M.B.A. Student Association.** Membership in the M.B.A. Student Association is automatic and requires no dues payment. The Association acts as a liaison between the students and faculty and administration in both academic and non-academic matters. The structure of the Association includes several standing and ad hoc committees dealing with concerns such as admissions and placement, computer and library facilities, intramural sports participation, and social events.

**Cocurricular and Recreational Activities.** Graduate students at Duke University are welcome to use recreation facilities and to affiliate with choral, dance, drama, music, and religious groups. They may become junior members of the American Association of University Professors and may affiliate with Phi Beta Kappa and social fraternities. Graduate women and wives of graduate students may join the Graduate Women's Club.

A full program of cocurricular and recreational activities is presented by the Associated Students of Duke University, Cultural Affairs Office, Duke Uni-

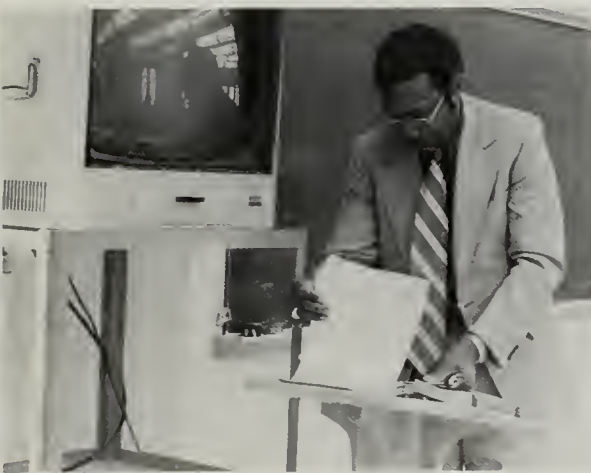
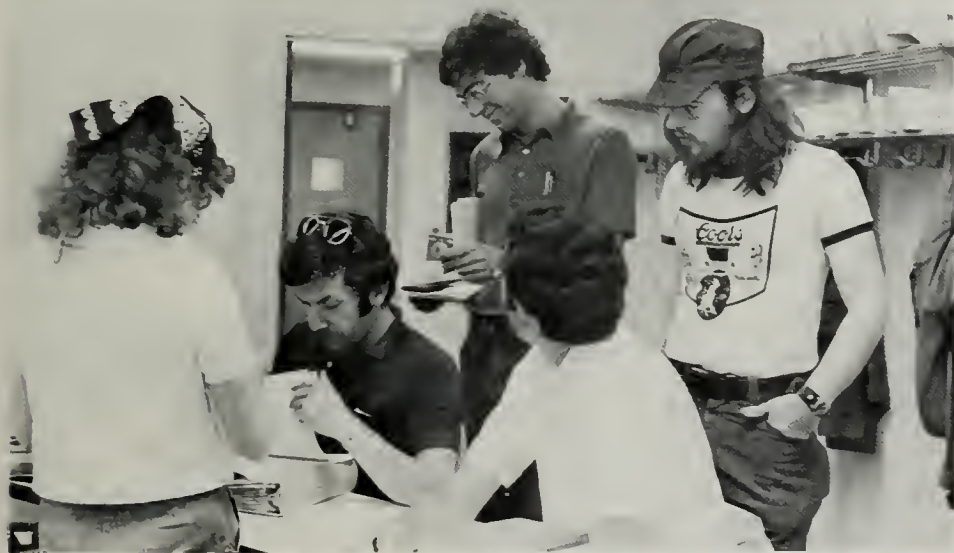


versity Christian Council, Duke University Union, Student Activities Office, Y.M.C.A., Y.W.C.A., and recreational clubs. Most programs are open to the entire University community. Inquiries should be directed to the ASDU Office; Duke Chapel; the Office of Cultural Affairs, 107 Page Building; the Duke University Union, 207 Flowers Building; or the Student Activities Office, 204 Flowers Building.

The Information Center, Page Box Office, publications offices, art gallery, meeting rooms, lounges, and recreational facilities are located in the Flowers and Union Buildings.

Full information regarding the scheduling of major events and programs for the entire year will be found in the Duke University Annual Calendar; detailed and updated information in the weekly *Calendar*, available on each Friday; and the *Duke Chronicle*, available each Monday through Friday. Copies may be obtained at the Information Desk or the Calendar Office, 107 Page Building.

**Intramural Athletics.** The Duke intramural programs provide all students



an opportunity to participate in some form of informal and competitive physical activity.

The men's program consists of seventeen different activities which include archery, bowling, cross country, golf, handball, horseshoes, tennis, flag football, badminton, paddle ball, basketball, swimming, table tennis, volleyball, wrestling, softball, and track. In a typical year more than 3,000 students compete for the many intramural titles and trophies that are awarded. Each year Duke, North Carolina, North Carolina State, and Wake Forest meet in the annual Big Four Intramural Day.

The women's program encompasses competition in badminton, basketball, bowling, tennis, and volleyball. In addition, special events in other areas of interest are conducted, and various clubs including modern dance, water ballet, and other sports offer the student opportunities to take part in extracurricular activities.

Through coed intramurals, the student is encouraged to participate on a less competitive level promoting relaxed social as well as physical activity. Opportunities for coed competition are provided in the areas of badminton, table tennis, tennis, and volleyball. Numerous other activities are being planned so that women will have opportunities similar to those available for men.

The University's varied athletic and recreational facilities and equipment are available for use by the students. The facilities for recreation include a golf course, lighted tennis courts, three swimming pools, a student activities building, three gymnasiums, outdoor handball and basketball courts, an all-weather track, and numerous playing fields and informal recreational areas. A variety of clubs dealing with archery, gymnastics, scuba diving, sailing, cycling, badminton, karate, rugby, soccer, and other activities are available to interested students.

**Medical Care.** The aim of the University Health Service is to provide any medical care and health advice necessary to the student as a member of the University community. The Health Service maintains the University Health Services Clinic located in the Pickens Building on West Campus and the University Infirmary on the East Campus. Emergency transportation can be obtained from the Duke Campus Police.

The Student Health Program offers varied benefits. To secure these benefits, a full-time graduate student must be in residence and (1) during fall and spring semesters be registered for at least 9 units per semester until he has passed the doctoral preliminary examination, after which a full-time student may be registered for 3 units in residence, or (2) in the summer session be registered for at least 1 unit of research or 3 units of course work.

Under this program the University Health Services Clinic offers the student outpatient services, routine laboratory and X-ray examinations in the clinic for the treatment of acute illness or injury, and advice and assistance in arranging consultations or medical treatment. Fees for such consultations or treatments must be paid by the student if he is not covered by an insurance plan.

Under this program the facilities of the University Infirmary are available during the regular session from the opening of the University in the fall until Graduation Day in the spring to all currently enrolled full-time students in residence. Hospitalization in the University Infirmary is provided for treatment of acute illness or injury as authorized by the University Health Services Clinic physician. Students are required to pay for their meals while confined to the Infirmary.

The Student Mental Health Service, located in the Pickens Rehabilitation Building, provides evaluations and brief counseling and/or treatment of matters ranging from questions about normal growth and development to the most

serious psychiatric disorders. Students may have up to four appointments per year with the Student Mental Health Service at no charge. Further interviews can be arranged, either with this staff or with a variety of other professionals, at a fee commensurate with the student's ability to pay.

All Duke University Medical Center resources are available to all Duke students and their spouses and children, although any bills incurred at Duke Hospital or any other hospital are the responsibility of the student, if he is not covered by an insurance plan. The Student Health Program does not provide health care for spouses and dependent children of married students.

The University has made arrangements with the Monumental Life Insurance Company for a Student Accident and Sickness Insurance Plan to cover all full-time students for a twelve-month period. The 1975-76 rate is \$46.10 per student. For additional fees a student may obtain coverage for a spouse or spouse and child. Although participation in this program is on a voluntary basis, the University expects all graduate students to be financially responsible for medical expenses above those covered by the University Student Health Program through the University Accident and Sickness Policy, a private policy, or personal financial resources. Students who have equivalent medical insurance or wish to accept the financial responsibility for any medical expense may elect not to take the Duke Plan by signing a statement to this effect. Each full-time student in residence must purchase this student health insurance or indicate the alternative arrangement. The Student Accident and Sickness Insurance Policy provides protection twenty-four hours per day during the full twelve-month term of the policy for each student insured. Students are covered on and off the campus, at home, or while traveling between home and school and during interim vacation periods. The term of the policy is from August 26. Coverage and services are subject to change each year as deemed necessary by the University in terms of costs and usage.

**Motor Vehicles.** Each member of the Duke academic community possessing or maintaining a motor vehicle at Duke University is required to register it with the University. Students do so annually at the beginning of the fall semester. If a student acquires a motor vehicle and maintains it at Duke University after the beginning of classes, it must be registered within five calendar days after operation on the campuses begins. Resident students are required to pay an annual fee of \$20 for each automobile and \$10 for each two-wheeled vehicle.

At the time of registration of a motor vehicle, the following documents must be presented: state vehicle registration certificate; valid driver's license; and satisfactory evidence of automobile liability insurance coverage with limits of at least \$10,000 per person and a \$20,000 per accident for personal injuries, and \$5,000 for property damage, as required by the North Carolina Motor Vehicle Law.

**Standards of Conduct.** Duke University expects and will require of all its students continuing loyal cooperation in developing and maintaining high standards of scholarship and conduct. The University wishes to emphasize its policy that all students are subject to the rules and regulations of the University currently in effect or which are put into effect from time to time by the appropriate authorities of the University.

Any student in accepting admission indicates his willingness to subscribe to and be governed by these rules and regulations and acknowledges the right of the University to take such disciplinary action, including suspension and/or expulsion, as may be deemed appropriate, for failure to abide by such rules and regulations or for conduct adjudged unsatisfactory or detrimental to the University.





## Courses of Instruction





## Master of Business Administration

**300. Managerial Economics I.** Develops the fundamental theory of the firm on which the analysis and planning of operations for an economic enterprise are based. Competitive price and non-price behavior in single and multiple market segments, cooperative market behavior, alternative market forms, the rationale for and form of government regulation, and production and investments are examined through the use of economic theory. Emphasis is on the identification and solution of planning problems of the firm in alternative market settings and development of students' abilities to employ economic reasoning in the decision-making process. Cases and problems are utilized to reinforce course material. 5 units.

**301. Managerial Economics II.** Focuses on developing an understanding of the economic environment of the organization with special emphasis on the determination of price level, rate of growth, interest rates, and the level of aggregate income, employment, and output in the economy. Attention is also given to an examination of such current economic issues as inflation, international economic relations, and unemployment. The purpose is to develop a fundamental understanding of the economic environment of the organization, the types of government policies that affect the economic environment, and the impact that such policies have. 3 units.

**310. Mathematics for Management.** Develops the basic mathematical structures and techniques which provide a framework for understanding and analyzing decision problems of an enterprise. Specific topics include sets, relations, functions of several variables, classical optimization techniques, linear algebra, linear programming, and probability theory. Applications, cases, and problems are used to illustrate the relevance of quantitative analysis in a decision context.

Conducted parallel with the foregoing is a subcourse on computer systems, which emphasizes the use of the computer for support of the decision-making process. Topics include computer technology, hardware, software, use of computer systems, and the PL/1 computer language. Several problems from other courses in the first semester are solved using the computer. 5 units.

**311. Statistical Analysis for Management Decisions.** Builds upon Business Administration 310 and extends to an examination of classical and Bayesian statistics as a framework and methodology for decision-making. Included are topics such as sampling theory, estimation, hypothesis testing, regression and correlation analysis, utility theory, and statistical decision theory. 4 units.

**312. Operations Research.** Deals with the development and study of quantitative models which are useful for structuring and solving strategy problems of the firm, and which are used in the third and fourth semester strategy courses. Special emphasis is given to structuring problems in terms of quantitative models, generating solutions (using both analytical and simulation approaches) with and without computers, performing sensitivity analyses, implementing solutions, and developing a proper perspective about the role and usefulness of quantitative models in management decision processes. 3 units.

**313. Advanced Operations Research.** Deals with problems of organization for an operations research project, formulation of the problem, model construction, interpretation of analytical results, and implementation. Selected cases of particular applications of operations research from the literature serve as a basis for much of the class work. Students work in local industry, the University, the medical center, or in other cooperating agencies on operations research problems. Methodologically, some attention is devoted to advanced solution techniques as necessary to complete student projects, but primary attention is focused on formulation and use of models, the modification of existing models, or the development of new ones. 3 units.

**320-321. Organization Theory and Management I, II.** Provides the first year M.B.A. degree student with an understanding of macroscopic (corporate level) and microscopic (small-group and individual level) organizational phenomena. At the macroscopic level, these courses are concerned with the study of organizations as socioeconomic-political systems for collective action imbedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization (with particular emphasis placed on modern, systems, and cybernetic approaches), and (2) introduction to organization design with particular emphasis placed on goal formation, performance measurement, decomposition, administrative mechanisms for coordination and control, and organization change and adaptation. At the microscopic level, these courses examine the social and psychological foundations necessary to understand the behavior and dynamics of individuals and small groups within organized settings as well as the administrative strategies available to the firm for influencing and modifying such behavior. To provide students with an empirically rich, cooperative-competitive learning experience, small-and large-group projects, business games, and cases may be used. Specific lecture topics include: (1) individual motivation and perception, (2) small group dynamics, and (3) informal organization. The assignment of specific areas to a particular course depends on the instructor. 3 units each.

**330. Accounting Systems I.** Introduces the student to the types of information requirements imposed on the firm by agencies in its environment and develops an understanding of the activities of the firm within the framework of a financial accounting system designed to satisfy these information requirements. The financial accounting system is treated as an input-output information gathering and reporting system which provides a conceptual model of the firm and reflects the impact of exchange transactions between the firm and its environment. Emphasis is given to the study of financial accounting reporting and measurement problems from a theoretical and an applied basis, using cases and





topical problems in financial accounting as a foundation for the learning experience. 3 units.

**331. Accounting Systems II.** Establishes the relationships between the strategies of the firm as reflected in its planning activities and the impact of those plans on the data gathering, reporting activities, and operations inside the firm. The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system to serve as a mechanism for internal management and control. Specific topics include budgeting, standard costing, control in a programmed environment, capital budgeting, and funds analysis. Cases, together with a variety of brief problem exercises, are utilized as a basis for the development of the material in this course. 3 units.

**333. Controllership.** Develops systems for collecting and summarizing data in a manner which meets the requirements of the management team in controlling and planning operations. The function of the controller, as the center of synthesis and analysis of data, is studied in the context of the foundations established during the first three semesters. 3 units.

**334. External Reporting and Auditing.** Builds on the information systems sequence of the first year and the public policy course in terms of developing requirements of the system for reporting to parties external to the firm. These parties may have need for information about the activities of the enterprise for decision-making purposes. Communication and measurement problems as well as the role of the independent auditor in developing evidence of and attesting to the reliability of data are studied in detail. 3 units.

**335. Management Information and Control Systems.** Focuses on the set of problems associated with the design and operation of the information systems necessary to support strategic planning of an organization and to support the organization's control system. Specific attention is given to the role of information in planning and control, the economics of information, the dynamics of information flows, technologies of information systems, information system design, data base construction and maintenance, and reporting systems. 3 units.

**345. Legal Environment of the Firm.** Considers the legal environment of the firm with emphasis on the legal system, the process by which laws are formulated and changed, and the type and forms of legal constraints imposed on firms. Also examined are major legislation, court cases, and regulation by federal agencies which affect the firm's decisions. 2 units.

**346. Public Policy of the Firm.** Builds on the theory of market failure to describe the rationale for societal intervention in business activities and reasonable firm responses. Among the topics discussed are environmental action, monopoly relation, discrimination, poverty, consumer issues, and problems arising from shifts in demand and supply. The emphasis is on the role of the business firm in solving societal problems. 3 units.

**355. Financial Strategy.** Focuses on the set of strategic problems associated with the acquisition of financial resources from the external market and their effective utilization and control within the organization. Specific attention is given to capital markets, evaluation of the firm, short-run resource planning (cash, inventory, receivables, and short and intermediate-term financing), and long-run resource planning (investment in long-lived assets, leasing, debt and equity financing, dividend policy, and the cost of capital). Institutional aspects of financial markets are emphasized only to the extent that they provide necessary insights into the problems of planning financial strategy. 3 units.



**356. Finance.** Focuses on management of the financial affairs of the firm in its attempt to develop an optimal capital structure and includes: (1) the sale of corporate securities of all varieties and the related knowledge about the requirements of investors at particular points in time, and (2) the translation of plans and programs into needs which must in turn be met by cash resources from either internal or external sources. 3 units.

**365. Market Strategy.** Focuses on the set of strategic problems associated with providing a set of products or services to consumers; and with procuring resources and services from suppliers in a manner that contributes to objectives of the organization. Specific attention is given to the analysis of market opportunities, product mix strategy, market segmentation, design of distribution and procurement channels, price and promotion strategy, and sales force decisions. 3 units.

**366. Marketing.** Applies the general theories previously studied to the firm's marketing problems. Definition and resolution of these problems involve a more detailed discussion of the existing market environment of the firm. Problems studied are those of consumer behavior, marketing structures, product planning, pricing, promotion, logistics, and marketing research. 3 units.

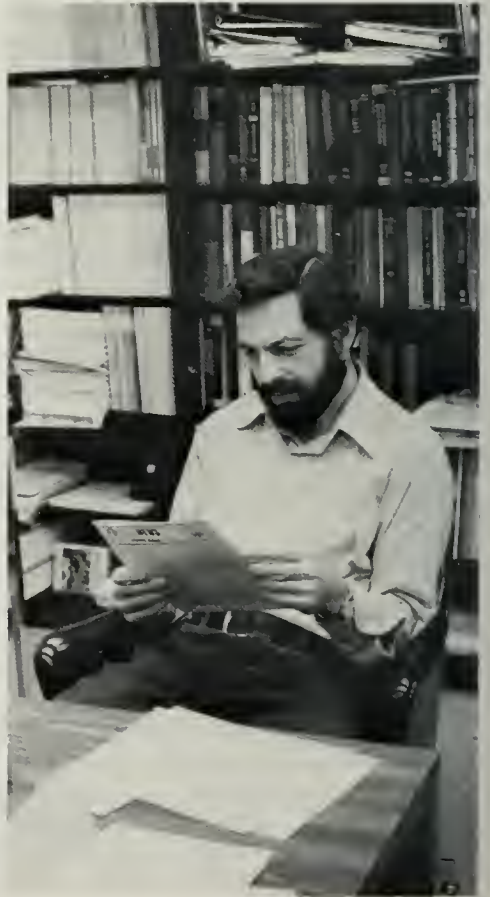
**375. Operations Strategy.** Focuses on the set of strategic problems associated with the design, operation, and control of the transformation processes utilized by an organization in producing goods and services for its external markets. Specific attention is given to systems design (product design, process design, capacity planning), system operation (production planning, scheduling) and system control (inventory control, quality control). 3 units.

**376. Production.** Provides the student with experience in applying the theories developed during the first three semesters to problems of professional practice in the area of production management. Two major problem areas are covered—first, the design (or planning) of manufacturing systems and second, their operation (or control). Sub-topics under design include plant layout, economic evaluation of materials, methods and processes, facilities planning. Sub-topics under operation include cost, inventory and quality control, short-run scheduling and capacity utilization, maintenance, start-up problems, and equipment replacement. 3 units.

**381. Management of Financial Institutions.** Explores various ways in which management science techniques can be applied to the management problems of financial institutions, especially commercial banks. The course will examine several types of financial institutions, consider the role that they play in the American economy, and focus on the use of management science techniques for helping executives cope with planning, decision-making, and control problems. 3 units.

**382. Multinational Enterprise.** Focuses on the nature and consequences of multinational corporations. Studies the international economic environment in which multinational corporations operate, the problems of managing a multinational corporation, and the public policy toward multinational corporations. 3 units.

**385. Strategy of the Organization I.** Focuses on the problems of formulating strategy for the organization, of decomposing aggregate strategy problems into manageable sub-problems, and of integrating and coordinating strategies designed for sub-problems into a consistent and implementable strategy for the organization as a whole. Specific attention is given to objectives of the organization in a complex environment, the objective setting process, short- and long-



run strategy planning, methods for decomposing strategy planning, mechanisms for achieving integration and coordination of strategy, and the role of management information systems in strategy planning. 2 units.

**386. Strategy of the Organization II.** Integrates the strategy planning and control process, organization design, and management-information systems in order to achieve the objectives of the organization. Attention is given to strategy formulation, implementation, and control from the viewpoint of the organization as a whole and to the design of structures for the coordination and control of the organization. The cooperation and competitive relations of the firm with its environment are also investigated. 4 units.

**390. The Practicum.** Gives the student a significant experience in applying the concepts, theories, and methods of analysis he learns in the program to a real, complex problem of an economic enterprise. It should include the analysis of a situation and the explicit formulation of a problem. The important task of identifying and specifying the problem is an integral part of the Practicum.

The Practicum report should propose a solution to the problem and should contain the supporting explanation and logic. The solution should be one that can be implemented, not requiring unavailable resources. 3 units.

**391.1-9. Special Topics in Management.** Some elective courses may be offered as Special Topics in Management on an occasional basis depending on the availability and interests of students and faculty. Such courses might pertain to Management of the Nonprofit Enterprise, Advanced Organization Theory, Marketing Research, Manpower Planning. 1 to 5 units.

## Master of Science in Management

**300. Managerial Economics.** The fundamental theory of the firm on which analysis and planning of economic activity is based. Topics include: consumer demand, perfect competition, imperfect competition, capital theory, and welfare economics. Emphasis will be placed on the application of these theories to existing corporate resource allocation problems. 4 units.

**310. Quantitative Methods.** Mathematical foundations for the quantitative analysis of management problems. Topics include: optimization, linear algebra, and probability. Prerequisite: Management Science 318. 4 units.

**311. Statistics.** Statistical foundations for the quantitative analysis of management problems. Topics include: classical statistics, Bayesian statistics, and regression models. Prerequisite: Management Science 310. 4 units.

**312. Operations Research.** Deterministic and probabilistic models useful in the analysis of management problems, with particular emphasis on model formulation, information requirements, model validation, sensitivity analysis, and utilization of model outputs in problem-solving. Topics include: mathematical programming, decision-making under uncertainty, and digital simulation. 4 units.

**318. Calculus for Management.** An introductory treatment of calculus for graduate students in management. 2 units.

**320. Organization Analysis and Design.** A macroscopic study of organizations as socioeconomic-political systems for collective action imbedded in an uncontrollable environment. Specific topics include: (1) alternative theories of organization, with particular emphasis on modern, systems, and cybernetic approaches, and (2) introduction to organization design with particular emphasis



on goal formation, performance measurement, decomposition, administration mechanisms for coordination and control, and organization change and adaptation. 4 units.

**330. Accounting and Control Systems.** The concept of the master budget is used to establish a basis for quantifying the planning activities of the firm and for developing a financial feedback and control system for internal management and control. After a brief introduction to and review of basic data accumulation systems, the topics for study include budgeting, standard costs and variance analysis, capital budgeting, and activity analysis. 4 units.

**333. Controllership.** The need for control and effective ways to provide it, primarily through budgetary processes. Special attention is devoted to project evaluation, control reports, and analysis of the variance between planned results and actual results. 4 units.

**341. External Environment of the Firm.** An examination of the way in which society, through the mechanism of government, affects the decisions of business firms. Attention is focused on macro-economic, legal, and social factors in the firm's environment. 4 units.

**351. Financial Management.** Sources and uses of financial resources for the firm. Capital budgeting, cash management, and the mix of external financing are examined in the context of attempts to achieve the optimal capital structure of the firm. 4 units.

**361. Marketing Management.** Analysis of the firm's general market competitive and cooperative strategy problem. Specific problem areas include pricing, product and product line design, promotion, logistics, research, the relationships among these various problem areas, and their solutions. 4 units.

**371. Operations Management.** Design of manufacturing systems—operating rules and policies. Topics investigated are choice of technology, design of the physical system, development of operating procedures and decision rules for scheduling, inventory, cost control, quality assurance, and the interaction of manufacturing with other functions of the firm. 4 units.

**380. Planning and Control Problems of the Firm.** An introduction to the functional areas of the typical firm and an integrated treatment of the strategic problems involved in economic enterprise. 8 units.

**390. Practicum.** An applied project in which the student identifies, formulates, analyzes, and proposes a solution to a practical problem. The subject will ordinarily be a management problem from the organization in which the student works. 4 units.

**391. Special Topics in Management.** Examination of a specialized area in the field of management. Credit hours to be arranged.

## Doctor of Philosophy

**309.1-.9. Research in Managerial Economics.** Credit hours 1-6.

**319.1-.9. Research in Quantitative Methods.** Credit hours 1-6.

**329.1-.9. Research in Organization Theory and Management.** Credit hours 1-6.

**339.1-.9. Research in Information and Accounting Systems.** Credit hours 1-6.

**349.1-.9. Research in Public Policy and Social Responsibility.** Credit hours 1-6.



359.1-.9. Research in Finance. Credit hours 1-6.  
369.1-.9. Research in Marketing. Credit hours 1-6.  
379.1-.9. Research in Production. Credit hours 1-6.  
392-393. Tutorial in Interdisciplinary Areas. Credit hours 1-6.  
397. Dissertation Research.





Faculty

The faculty of the Graduate School of Business Administration has a diverse educational and professional background. This diversity provides the student the opportunity to explore wide-ranging aspects of the environment in which he will live and work after completing his educational experience.

The student-faculty ratio in the School is maintained at a level permitting development of close professional relationships and encouraging individual assistance in academic and professional development. The student-teaching faculty ratio is about seven to one. In addition, faculty engaged in major research projects and other teaching assignments are available to work with students. This balance is advantageous for both students and faculty in their joint work.

A brief description of the background and main areas of interest of the faculty follows:

**A. Rashad Abdel-Khalik**, Ph.D., *Associate Professor of Business Administration*; B. Com. (Cairo University), M.B.A., A.M. (Indiana University), Ph.D. (University of Illinois).

Professor Abdel-Khalik came to Duke from Columbia University where he spent three years as assistant and associate professor. His areas of interest include financial corporate reporting, accounting theory, managerial accounting, and management information systems. He is a frequent contributor to *The Accounting Review* and other professional journals.



**Carole A. Aldrich**, Ph.D., *Assistant Professor of Business Administration*; B.S., M.S.I.A., Ph.D. (Carnegie-Mellon University).

Professor Aldrich teaches in the fields of marketing, public policy and economic theory. Her research interests lie in the area of economic models of the firm with emphasis on the theory of dynamic problems. Recent publications have dealt with research and development funding under uncertain conditions.







**Kenneth R. Baker, Ph.D.**, *Associate Professor of Business Administration and Director of the Master of Science in Management Program*; A.B. (Harvard University), Ph.D. (Cornell University).

Professor Baker's interests include operations research, operations management, production planning, and scheduling. Prior to coming to Duke, he taught at the University of Michigan, where he received two outstanding teaching awards, and at North Carolina State University. He is a member of the editorial board of *AIIE Transactions* and is the author of a recently published book, *Introduction to Sequencing and Scheduling*.



**Helmy H. Baligh, Ph.D.**, *Professor of Business Administration*; B.A. (Oxford University), M.B.A., Ph.D. (University of California at Berkeley).

Professor Baligh joined the Duke faculty after teaching at the University of Illinois. His major research is in the analysis and design of vertical market structures for both business and social purposes. He has participated in the development of the Master of Business Administration programs at Duke and at the University of Illinois with emphasis on curriculum. Professor Baligh has also served as Associate Dean of the Graduate School of Business Administration. His publications include *Vertical Market Structures* (with Leon E. Richartz) and several articles in the areas of transportation, hospital administration, and economics. He teaches in the fields of marketing and economic strategies.



**Joseph Battle, Ph.D.**, *Associate Professor of Business Administration and Director of the Master of Business Administration Program*; B.S. (North Carolina Central University), M.S., Ph.D. (University of Michigan).

After serving as Special Assistant to the President of Shaw University, Professor Battle joined the Duke faculty, teaching in the areas of mathematics, probability and statistics, and economics. Research and consulting interests include the evaluation of federally-funded poverty agencies with the Research Triangle Institute and local Durham organizations.



**Colin C. Blaydon, Ph.D.**, *Associate Professor of Business Administration and Policy Sciences*; B.E.E. (University of Virginia), Ph.D. (Harvard University).

Professor Blaydon has taught in the areas of corporate finance, managerial economics, and operations research. He also worked for the Office of Management and Budget in policy formulation and implementation in pension reform, health manpower, national health insurance, and housing finance. His current research is involved with social security and pension plans.



**Richard M. Burton, D.B.A.**, *Associate Professor of Business Administration*; B.S., M.B.A., D.B.A. (University of Illinois).

Professor Burton's primary research interests are in the design of organizations for decision-making, process quality and control, and make-buy decisions. He came to Duke after teaching operations research at the Naval Postgraduate School in Monterey, California. His teaching fields include organizational theory, managerial economics, and business strategy. He has served as a consultant on Manpower Issues to the United States Senate and to IBM.



**Kalman J. Cohen, Ph.D.**, *Distinguished Bank Research Professor*; B.A. (Reed College), B.Litt. (Oxford University), M.S., Ph.D. (Carnegie-Mellon University).

Prior to joining the Duke faculty, Professor Cohen served for two years as Distinguished Professor of Finance and Economics and as the first Director of the Salomon Brothers Center for the Study of Financial Institutions at New York University. He also spent fourteen years on the faculty of Carnegie-Mellon University's Graduate School of Industrial Administration. He has written five books and over fifty articles in the areas of banking and finance, strategic planning, management science, and computer simulation. He has pioneered in the applications of management science techniques in banking.





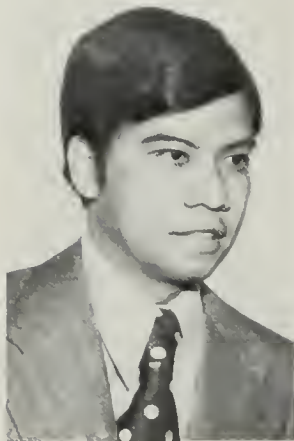
**William W. Damon, Ph.D.**, *Assistant Professor of Business Administration*; B.S. (Purdue University), M.B.A., Ph.D. (Cornell University).

Professor Damon teaches in the fields of operations research, quantitative methods, and organization theory. His research interests are in the modeling of the interaction of the functional areas of the firm and the implications of this interaction in organization design. He has been involved in the development of structure and methodology for the evaluation of public policy with respect to the allocation of resources to the care of the elderly. He is also involved in curriculum development.



**David C. Dellinger, Ph.D.**, *Associate Professor of Business Administration*; B.S. (Duke University), M.S., Ph.D. (Stanford University).

Professor Dellinger's current research, sponsored by the Administration on Aging, is a joint project with the Duke Center for the Study of Aging, developing cost-effectiveness methodology for evaluating programs of care for the aged. He has also done consulting work for the United States Senate Committee on Armed Services dealing with Officer Manpower Management Systems. His teaching fields include operations research and economics, and he has been active in curriculum development with the Duke Master of Business Administration Program.



**Jose A. Espejo, Ph.D.**, *Assistant Professor of Business Administration*; B.A. (Ateneo de Manila University), M.B.A., Ph.D. (Columbia University).

Professor Espejo's teaching interests are in finance, international business, and quantitative methods. His recent research, involved with forecasting and management of capital budgeting, is enhanced by his past employment with Doubleday & Company as a senior financial analyst and by his consulting work with Avon Products, Incorporated in the areas of corporate planning and forecasting.

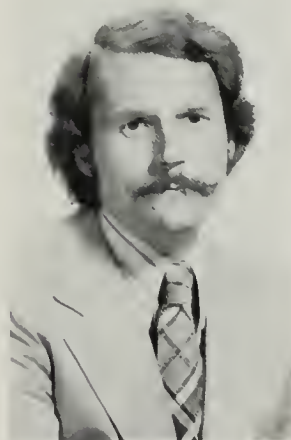
**Thomas F. Keller**, Ph.D., C.P.A., *Dean and R. J. Reynolds Industries Professor of Business Administration*; A.B. (Duke University), M.B.A., Ph.D. (University of Michigan).

Professor Keller specializes in accounting, and has held several offices in the American Accounting Association, including Editor of *The Accounting Review* (1972-75). His interest lies in design and management of information and control systems for external reporting purposes. Consulting work includes the University of Nebraska and the G.A.O. He traveled to Australia and the Far East under a Fulbright grant during the summer and fall of 1975.



**Arthur J. Kuhn**, Ph.D., *Assistant Professor of Business Administration*; B.S., M.B.A. (University of Illinois), Ph.D. (University of California at Berkeley).

Organization, system, and control theory as applied to the design of performance control systems are Professor Kuhn's major teaching and research interests. His current work attempts to explain the underlying causes for the performance differences between the General Motors Corporation and the Ford Motor Company during the period 1920 to 1937. Professor Kuhn serves as a consultant to the North Carolina Governor's Council on Aging.



**Arie Y. Lewin**, Ph.D., *Professor of Business Administration*; B.S., M.S. (University of California at Los Angeles), M.S., Ph.D. (Carnegie-Mellon University).

Prior to coming to Duke, Professor Lewin was on the faculty of New York University for eight years. His research interests focus on applications of behavioral science research to specific functional areas. He has written two books, and is a departmental editor of *Management Science*. Teaching interests include organization theory and public policy of the firm.





Wesley A. Magat, Ph.D., *Assistant Professor of Business Administration*; A.B. (Brown University), M.S., Ph.D. (Northwestern University).

Professor Magat's teaching interests are in managerial economics, public policy, and quantitative methods. His research is in the fields of industrial organization, environmental economics, and theory of regulation. Current work deals with the effect of regulation on technological advance.



Steven F. Maier, Ph.D., *Assistant Professor of Business Administration*; B.S. (Cornell University), M.S., Ph.D. (Stanford University).

Professor Maier's teaching and research interests are in the areas of operations research and corporate finance. Prior to joining the Duke faculty, he spent two years as a member of the professional staff at Stanford Research Institute. He has written papers on such topics as cash management, capital budgeting, and specialized computer language. He is currently serving as a consultant on cash management to two North Carolina banks.



Wayne Morse, Ph.D., C.P.A., *Associate Professor of Business Administration*; B.B.A. (Siena College), M.B.A. (Cornell University), Ph.D. (Michigan State University).

Managerial accounting is Professor Morse's major teaching interest. He joined the Duke faculty after four years of teaching at the University of Illinois. Professor Morse's research is concerned with human resource accounting, the potential application of managerial accounting models to financial accounting, examination of the learning-curve phenomenon and its limitations, and the accounting applications of matrix algebra.



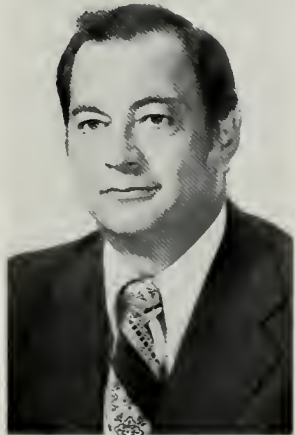
**David W. Peterson, Ph.D.**, *Professor of Business Administration and Director of the Ph.D. Program*; B.A. (University of Wisconsin), M.S., Ph.D. (Stanford University).

Professor Peterson's teaching and research activities are in the fields of information systems, mathematical modeling, and operations research. He has published numerous articles, appeared as an expert witness on statistical matters, and has been very active in curriculum review and revision. He has also been a guest lecturer at both domestic and international conferences in recent years.



**W. Travis Porter, J.D.**, *Adjunct Professor of Business Law*; B.A. (University of North Carolina), J.D. (University of North Carolina School of Law).

The legal environment of the firm is the subject matter of Professor Porter's Master of Business Administration course. He is actively involved in the private practice of law as Executive Vice President of the law firm of Powe, Porter, Alphin and Whichard, P.A.



**Howard O. Rockness, Ph.D.**, *Visiting Assistant Professor of Business Administration*; B.S., M.B.A., Ph.D. (University of Washington).

Professor Rockness' teaching interest is in the field of accounting. His research lies in the areas of accounting, social psychology, and economics. Professor Rockness is visiting from the faculty of the University of North Carolina.





**James Howard Scheiner, Ph.D., C.P.A.,** *Assistant Professor of Business Administration; B.S., M.B.A. (Washington University), M.A., Ph.D. (Ohio State University).*

Professor Scheiner teaches in the financial accounting field. His research interests are concentrated on the application of mathematical programming theory in financial accounting. He has also examined methods for determining optimal accounting policies for interrelated problem areas.



**Robert Taylor, Ph.D.,** *Assistant Professor of Business Administration; B.B.A., M.B.A. (Western Michigan University), Ph.D. (University of North Carolina).*

Professor Taylor teaches in the areas of accounting and information systems and human resource allocation. Areas of research have included the examination of environmental, organizational, and psychological variables which influence filtering of external communications intended to change organizational policies. He is currently interested in human resource assessment in complex organizations.



**James Vander Weide, Ph.D.,** *Assistant Professor of Business Administration; B.S. (Cornell University), Ph.D. (Northwestern University).*

Professor Vander Weide's primary research and teaching interests are in the areas of corporate finance and managerial economics. He has written papers on topics such as cash management, cost of capital, capital budgeting, and portfolio analysis. He has also served as a consultant to several North Carolina banks in the area of cash management, and has appeared before several state utility commissions as an expert witness on the cost of capital.

**James Walton Vaupel**, M.P.P., *Lecturer in Business Administration and Policy Sciences*, B.A., M.P.P., (Harvard University).

Professor Vaupel teaches in the area of multinational enterprise. His recent research and publications are concerned with analytical decision-making and its application to public policy formulation. He serves as a research associate of the Harvard Multinational Enterprise Project.



**Robert A. Westbrook**, Ph.D., *Assistant Professor of Business Administration*; A.B., M.B.A., Ph.D. (University of Michigan).

Professor Westbrook teaches marketing with specific interests in marketing research, buyer behavior, advertising, and marketing and public policy. His research interests include the study of the role of personality theory in buyer behavior, market segmentation, and methodological research. Experience in these areas has been enhanced by his employment as a senior staff member of a marketing research and consulting firm.



**Julie H. Zalkind**, Ph.D., *Assistant Professor of Business Administration*; B.A. (Mount Holyoke College), M.S. (Stanford University), Ph.D. (The Johns Hopkins University).

Mathematical methods, including game theory, control theory, programming, and applications of operations research to economics are the basic teaching areas of Professor Zalkind. Primary research has been in the area of game theory. She has been active in curriculum development, is a member of the Academic Council, and serves as the coordinator between the Hospital Administration Department and the Graduate School of Business Administration.



# Appendix

## SECOND YEAR STUDENTS (CLASS OF 1975)

### M.B.A. Degree Recipients

Loran M. Adams, (United States Naval Academy), Applied Science  
R. Jay Anthony, (DePauw University), Economics/Romance Languages  
Daniel C. Bennett, (United States Naval Academy), Naval Science  
David P. Bennett, (Purdue University), Electrical Engineering  
Santosh Bhotika, (Indian Institute of Technology), Electrical Engineering  
Robert M. Bowker, (University of Rhode Island), Engineering Mathematics  
Robin Bradbury, (University of Pennsylvania), Finance  
George P. Cahill, (Duke University), Mechanical Engineering  
William H. Coleman, (Case Western Reserve University), History  
John M. Connor, (Drexel University), Nuclear Physics  
Russell L. Creighton, (Duke University), Mathematics  
Ronald D. Dearing, (University of Louisville), Mathematics  
N. Ranthi Dev, (Indian Institute of Technology), Chemical Engineering  
Robert DeVincentis, (Cornell University), Economics  
Mark G. DeWitt, (Bucknell University), Mathematics  
Robert M. Dragone, (University of Massachusetts), Forestry  
Michael T. Dunn, (Duke University), Management Science  
Joseph W. Frenzel, (United States Naval Academy), Engineering  
Thomas J. Gillespie, (Duke University), Biomedical Engineering  
Raymond F. Gorman, (Brown University), Mathematics/Economics  
Ben J. Heeb, (University of Washington), Mathematics  
John D. Herr, (Duke University), English  
John W.M. Johnson, (Duke University), Biological Sciences  
Walter M. Keel, (Wake Forest University), Accounting  
Stephen A. Lacks, (Duke University), Management Science  
Steven H. Layne, (Georgia Institute of Technology), Industrial Engineering  
John R. Leighton, (Duke University), Mechanical Engineering  
Stephen J. McLeod, (Duke University), Electrical Engineering  
Kevin J. McManus, (United States Air Force Academy), Humanities/Basic Science  
Garry M. Mlot, (University of Michigan), Chemical Engineering  
Kathleen A. Nelson, (Georgetown University), International Affairs  
Charles E. Parrish, (Vanderbilt University), Engineering Science  
George A. Raftelis, (Florida Presbyterian College), Mathematics  
Mark A. Sikkil, (Southern Methodist University), Industrial Engineering  
John O. Simons, (University of Pennsylvania), Political Science  
Thomas J. Tweeddale, (General Motors Institute), Electrical Engineering  
Robert J. Voytilla, (Ohio University), Electrical Engineering  
Brian V. Wilder, (University of Florida), Accounting

### M.B.A./J.D. Degree Recipient

James W. Mertzlufft, (Notre Dame University), Accounting

## FIRST YEAR STUDENTS (CLASS OF 1976)

### M.B.A. Degree Candidates

Alan R. Brown, (Ohio State University), Plant Pathology  
Gary P. Campanella, (Duke University), Psychology  
Kimberly A. Cox, (Virginia Polytechnic Institute), Finance  
David C. Douglass, (Gettysburg College), Economics  
Thomas E. Elliott, (Colorado State University), Humanities  
Scott L. Gelband, (University of Virginia), Psychology  
John M. Hayes, (Duke University), Civil Engineering  
Susan W. Hayes, (Duke University), Economics  
Paul M. Herron, (Trinity College), Economics  
Robert E. Howard, (North Carolina State University), Psychology  
Minoru Itosaka, (University of Tokyo), Economics  
Konstadinos Katsarakis, (National Technical University of Athens), Mechanical Engineering  
Robert G. Kolb, (Georgia Institute of Technology), Economics



Craig L. Meisel, (Duke University), Management Science  
 Ahmet Merey, (Bosphorus University), Business Administration  
 Janet R. Miller, (University of Michigan), Cellular Biology  
 R. Gregory Miller, (University of Michigan), Civil Engineering  
 R. David Mulligan, (Villanova University), Mechanical Engineering  
 Ralph C. Parrott, (Tulane University), Chemistry  
 Linda J. Powell, (Western Maryland College), Economics  
 Paul E. Prass, Jr., (St. Lawrence University), Geology  
 Kavassery Ramchand, (Indian Institute of Technology), Mechanical Engineering  
 Shakil A. Riaz, (Princeton University), Aerospace and Mechanical Sciences  
 Stephen A. Seeber, (Syracuse University), Economics/Political Science  
 Robert H. Shaw, (United States Naval Academy), Science  
 William R. Short, (Clemson University), Industrial Management  
 Robert C. Shrock, (Southampton College), Business  
 Tia M. Stackland, (Cornell College), Mathematics  
 Ronald W. Strandberg, (University of Pennsylvania), History  
 George H. Swain, Jr., (Duke University), Accounting  
 Brad H. Swimmer, (State University College at Geneseo, New York), Mathematics/Psychology  
 J. Kenneth Tate, (Vanderbilt University), Mathematics  
 Kevin M. Twomey, (University of Virginia), History  
 William A. Vogel, (Bucknell University), Accounting  
 Joan C. Wentworth, (Simmons College), Mathematics/Economics

#### **M.B.A./J.D. Degree Candidates**

John R. Cockle, (University of Nebraska), Economics  
 Michael A. Elder, (North Carolina State University), History  
 Jimmie L. Huitt, (Ohio State University), Economics  
 W. Bruce Johnson, (Duke University), Mathematics/Religion  
 Robert J. Kasper, (Stanford University), Economics  
 Gary E. Meringer, (University of Pennsylvania), Finance  
 Albert G. Moore, (Wake Forest University), Mathematics  
 William L. Peters, (West Virginia University), Statistics

# MAP OF DUKE UNIVERSITY

## East Campus

- |   |                         |    |                      |
|---|-------------------------|----|----------------------|
| A | Baldwin Auditorium      | O  | Pegram House         |
| B | Bassett House           | P  | Duke Press           |
| C | Brown House             | Q  | Infirmery            |
| D | Union Building          | R  | Ark                  |
| E | Faculty Apartments      | S  | Crowell Building     |
| F | Art Museum, Geology     | T  | Epworth Inn          |
| G | Aycock House            | U  | Gilbert-Addams House |
| H | East Duke Building      | V  | Southgate Hall       |
| I | West Duke Building      | W  | Campus Center        |
| J | Jarvis House            | X  | Woman's College      |
| K | Carr Building           |    | Gymnasium            |
| L | Giles House             | Y  | Asbury Building      |
| M | Woman's College Library | Z  | Bivins Building      |
| N | Alsapugh House          | AA | Art Building         |
|   |                         | BB | Branson Building     |



## West Campus

- |   |                                     |   |                                       |   |                                  |    |                                     |
|---|-------------------------------------|---|---------------------------------------|---|----------------------------------|----|-------------------------------------|
| A | Duke Chapel                         | H | Hospital Main Entrance                | O | Craven Quadrangle                | V  | Card Gymnasium                      |
| B | Divinity School                     | I | Gerontology, D & T, Clinical Research | P | Wannamaker Hall                  | W  | Indoor Stadium                      |
| C | Gray Building                       | J | Duke Hospital                         | Q | Crowell Quadrangle               | X  | School of Law                       |
| D | Perkins Library                     | K | Sociology Psychology                  | R | Clock Tower Court                | Y  | Gross Chemical Lab                  |
| E | Language Center                     | L | Social Sciences                       | S | Kilgo Quadrangle                 | Z  | Biological Sciences                 |
| F | Old Chemistry Building              | M | Allen Building                        | T | Union Building                   | AA | Plant Environment Laboratory        |
| G | Davison Building School of Medicine | N | Few Quadrangle                        | U | Flowers Building Page Auditorium | BB | Physics Building                    |
|   |                                     |   |                                       |   |                                  | CC | Nuclear Laboratory                  |
|   |                                     |   |                                       |   |                                  | DD | School of Engineering               |
|   |                                     |   |                                       |   |                                  | EE | Army Research                       |
|   |                                     |   |                                       |   |                                  | FF | Medical Center Res: Buildings       |
|   |                                     |   |                                       |   |                                  | GG | Nanaline H. Duke Sciences Building  |
|   |                                     |   |                                       |   |                                  | HH | Warehouse, Shop                     |
|   |                                     |   |                                       |   |                                  | II | Bell Building                       |
|   |                                     |   |                                       |   |                                  | JJ | Hanes House                         |
|   |                                     |   |                                       |   |                                  | KK | School of Nursing                   |
|   |                                     |   |                                       |   |                                  | LL | Hanes House Anne P. Center          |
|   |                                     |   |                                       |   |                                  | MM | Graduate Center                     |
|   |                                     |   |                                       |   |                                  | NN | Alumni House                        |
|   |                                     |   |                                       |   |                                  | OD | Commonwealth Studies Center         |
|   |                                     |   |                                       |   |                                  | PP | Personnel Office                    |
|   |                                     |   |                                       |   |                                  | QQ | International House                 |
|   |                                     |   |                                       |   |                                  | RR | Personnel Office                    |
|   |                                     |   |                                       |   |                                  | SS | Education Improvement Program       |
|   |                                     |   |                                       |   |                                  | TT | A Better Chance Program             |
|   |                                     |   |                                       |   |                                  | UU | International Student Center        |
|   |                                     |   |                                       |   |                                  | VV | Campus Stores Office                |
|   |                                     |   |                                       |   |                                  | WW | Office of Institutional Advancement |
|   |                                     |   |                                       |   |                                  | XX | Information Service                 |
|   |                                     |   |                                       |   |                                  | YY | Visitors Bureau                     |
|   |                                     |   |                                       |   |                                  | ZZ | Admissions Office                   |
|   |                                     |   |                                       |   |                                  |    | Edens Quadrangle                    |
|   |                                     |   |                                       |   |                                  |    | Wade Stadium                        |









# Bulletin of Duke University

Undergraduate  
Instruction

1976-1977





# **Bulletin of Duke University**

## **Undergraduate Instruction**

Trinity College of Arts and Sciences  
The School of Engineering  
The School of Nursing

**1976-1977**

Durham, North Carolina 1976

EDITOR  
Sharon Adler  
EDITORIAL ASSISTANT  
Elizabeth Matheson  
Duke University Bulletins Office

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Elizabeth Matheson

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# Contents

University Calendar	<i>iv</i>
University Administration	<i>v</i>
Boards of Visitors	<i>vii</i>

<b>General Information</b>	<i>viii</i>
----------------------------	-------------

<b>Degree Programs</b>	6
------------------------	---

Trinity College of Arts and Sciences	7
School of Engineering	16
School of Nursing	24

<b>Academic Procedures and Information</b>	28
--	----

Advanced Placement	29
Registration	32
Course Load and Eligibility for Courses	33
Declaration of Major or Division	34
Grading and Grade Requirements	35
Academic Honors	37
Prizes and Awards	38
Changes in Status	43
Study Elsewhere	45

<b>Cooperative Programs</b>	48
-----------------------------	----

Reciprocal Agreements	49
Continuing Education	49
Reserve Officers Training Corps	50

<b>Student Life</b>	54
---------------------	----

Residential Facilities	56
Services Available	57
Judicial System and Regulations	59
Student Activities	60

<b>Admission</b>	64
------------------	----

<b>Financial Information</b>	68
------------------------------	----

Tuition and Fees	69
Living Expenses	71
Student Aid	72

<b>Courses of Instructions</b>	78
--------------------------------	----

Trinity College of Arts and Sciences	78
The School of Nursing	243
The School of Engineering	247

Appendix	273
Index	293

# University Calendar—1976-1977

## 1976

### September

- 2 Thursday—Orientation begins: assemblies for new undergraduate students
- 7 Tuesday, 9:00 a.m.—Fall semester classes begin

### October

- 22 Friday—Last day for reporting midsemester grades

### November

- 1-3 Monday-Wednesday—Registration for spring, 1977
- 23 Tuesday, 6:00 p.m.—Thanksgiving recess begins
- 29 Monday, 9:00 a.m.—Classes are resumed

### December

- 12 Sunday—Founders' Day
- 13 Monday, 6:00 p.m.—Fall semester classes end
- 14 Tuesday—Reading Day
- 15 Wednesday—Final examinations begin
- 21 Tuesday—Final examinations end

## 1977

### January

- 6 Thursday—Orientation begins: assemblies for new students
- 10 Monday, 9:00 a.m.—Spring semester classes begin

### February

- 18 Friday—Last day for reporting midsemester grades

### March

- 4 Friday, 6:00 p.m.—Spring recess begins
- 14 Monday, 9:00 a.m.—Classes are resumed
- 28-31 Monday-Thursday—Registration for fall and summer, 1977

### April

- 22 Friday, 6:00 p.m.—Spring semester classes end
- 23-25 Saturday-Monday—Reading Period
- 26 Tuesday—Final examinations begin

### May

- 2 Monday—Final examinations end
- 7 Saturday—Commencement begins
- 8 Sunday—Commencement: Baccalaureate Service and Graduation Exercises

# University Administration

## General Administration

Terry Sanford, J.D., LL.D., D.H., L.H.D., D.P.A., *President*  
John O. Blackburn, Ph.D., *Chancellor*  
Frederic N. Cleaveland, Ph.D., *Provost*  
Charles B. Huestis, *Vice President for Business and Finance*  
William G. Anlyan, M.D., *Vice President for Health Affairs*  
Juanita M. Kreps, Ph.D., *Vice President*  
J. David Ross, J.D., *Vice President for Institutional Advancement*  
Victor A. Bubas, B.S., *Vice President for Community Relations*  
Stephen Cannada Harward, A.B., C.P.A., *Treasurer and Assistant Secretary*  
J. Peyton Fuller, A.B., *Assistant Vice President and Controller*  
Harold L. Lewis, Ph.D., *Vice Provost and Dean of Faculty*  
John C. McKinney, Ph.D., *Vice Provost and Dean of the Graduate School*  
John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*  
Ewald W. Busse, M.D., *Associate Provost and Director of Medical and Allied Health Education*  
John Shytte, M.S., *Director Pro Tem of Duke Hospitals*  
Frederick C. Joerg, M.B.A., *Assistant Provost for Academic Administration*  
Anne Flowers, Ed.D., *Assistant Provost for Educational Program Development*  
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*  
William C. Turner, Jr., M.Div., *Assistant Provost and Dean of Black Affairs*  
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*  
Joel L. Fleishman, LL.M., *Vice Chancellor for Public Policy Education and Research; Director of Institute for Policy Sciences and Public Affairs*  
Connie R. Dunlap, A.M.L.S., *Librarian*  
William E. King, Ph.D., *University Archivist*  
Clark R. Cahow, Ph.D., *University Registrar*  
Olan Lee Petty, Ph.D., *Director of Summer Session*  
Rufus H. Powell, LL.B., *Secretary of the University*  
Charles Linn Haslam, J.D., *University Counsel*

## Undergraduate Administration

John M. Fein, Ph.D., *Vice Provost and Dean of Trinity College of Arts and Sciences*  
Ruby L. Wilson, R.N., Ed.D., *Dean of the School of Nursing*  
Aleksandar Vesić, D.Sc., *Dean of the School of Engineering*  
Richard L. Wells, Ph.D., *Assistant Provost and Associate Dean of Trinity College of Arts and Sciences*  
William J. Griffith, A.B., *Assistant Provost and Dean of Student Affairs*  
William C. Turner, Jr., M.Div., *Assistant Provost and Dean of Black Affairs*  
Virginia S. Bryan, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences and Coordinator for Curriculum*  
Clark R. Cahow, Ph.D., *Director of Undergraduate Admissions and Financial Aid*  
Jane Monroe, B.S.N., *Associate Director of Continuing Education*  
David M. Clayborne, M.A., *Assistant Dean of Trinity College of Arts and Sciences*  
Richard L. Cox, B.D., Th.M., *Associate Dean of Student Affairs*  
James Douthat, B.D., *Associate Dean of Student Affairs*  
Walter G. Emge, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*  
Rhett T. George, Jr., Ph.D., *Assistant Dean of the School of Engineering*

Shirley Hanks, A.B., *Career Counselor*

Ada Most, R.N., Ed.D., *Director of Academic Programs of the School of Nursing*

Elaine T. Nagey, B.A., M.Ed., *Staff Assistant for Academic Affairs of the School of Nursing*

Elizabeth S. Nathans, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*

Jean F. O'Barr, Ph.D., *Director of Continuing Education*

Richard J. Rohlf, Ph.D., *Director of the University Counseling Center*

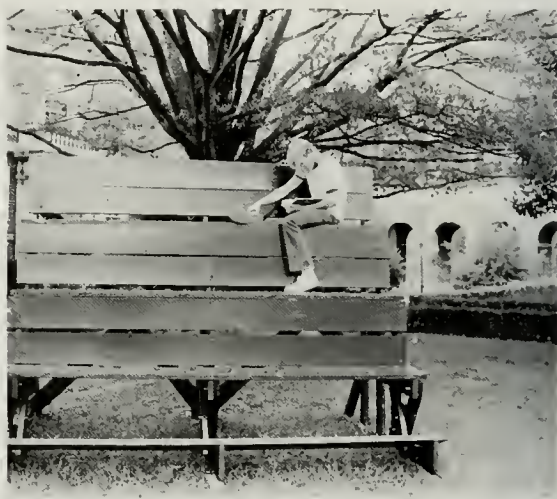
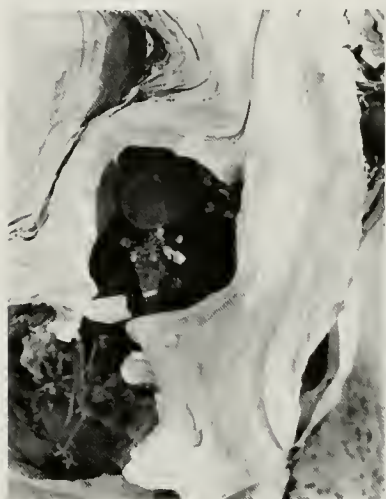
Eleanor Bradsher, *Assistant to the Dean of the School of Nursing*

Ella E. Shore, M.R.E., M.A., *Dean of Student Affairs of the School of Nursing*

Howard A. Strobel, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences and Coordinator for Federation Programs*

Gerald L. Wilson, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences and Coordinator for Deans' Staff*

Ellen W. Wittig, Ph.D., *Assistant Dean of Trinity College of Arts and Sciences*





## Boards of Visitors

### The School of Engineering

- Theodore G. Birdsall, *Professor, Department of Electrical and Computer Engineering, University of Michigan*  
George Bugliarello, *President, Polytechnic Institute of New York*  
Paul F. Chenea, *Vice President, General Motors Corporation*  
Harold L. Flowers, *Program Manager, McDonnell Douglas Astronautics Company*  
George R. Herbert, *President, Research Triangle Institute*  
William H. Huggins, *Westinghouse Professor, Department of Electrical Engineering, Johns Hopkins University*  
Kenneth H. Keller, *Professor, Department of Chemical Engineering and Materials Science, University of Minnesota*  
William S. Lee, *Vice President for Engineering and Construction, Duke Power Company*  
A. I. Mlavsky, *Executive Vice President, Mobil-Tyco, Solar Energy Corporation*  
Nathan M. Newmark, *Professor, Department of Civil Engineering, University of Illinois*  
Simon Ostrach, *Head, Division of Fluid, Thermal and Aerospace Sciences, Case Western Reserve University*  
Robert H. Pinnix, *President, R. H. Pinnix, Inc.*  
William M. Siebert, *Professor, Department of Electrical Engineering, Massachusetts Institute of Technology*  
Wilbur S. Smith, *Principal, Wilbur Smith and Associates, Consulting Engineers*  
W. Brewster Snow, *Consulting Engineer, Plainfield, New Jersey*  
F. W. Steckmest, *Consultant, Public Affairs, Shell Oil Company*  
Howard M. Winterson, *President, Combustion Engineering, Inc.*

### The School of Nursing (Medical Center)

- Karl D. Bays, *President, American Hospital Supply Corporation*  
Edward H. Benenson, *President, Benenson Management Company, Inc.*  
Earl W. Brian, *Secretary, Health and Welfare Agency of California*  
Shirley Chater, *Vice Chancellor, Academic Affairs and Professor of Nursing, University of California at San Francisco*  
John A.D. Cooper, *President, Association of American Medical Colleges*  
Kenneth R. Crispell, *Dean, School of Medicine, University of Virginia*  
Harry Eagle, *Associate Dean, Albert Einstein College of Medicine*  
James R. Felts, Jr., *Executive Director, Hospital and Child Care Sections, Duke Endowment*  
Loretta Ford, *Dean and Director of Nursing, University of Rochester*  
C. Henry Kempe, *Chairman and Professor of Pediatrics, University of Colorado*  
John K. Knowles, *President, Rockefeller Foundation*  
Alexander Leaf, *Chairman of the Department of Medicine, Harvard University Medical School*  
William H. Muller, *Chairman, Department of Surgery, University of Virginia*  
Raymond D. Nasher, *The Raymond D. Nasher Company*  
George Pallade, *Nobel Laureate, Yale University*  
William R. Pitts, *Physician, Charlotte, North Carolina*  
Anne R. Somers, *Associate Professor of Community Medicine, Rutgers University Medical School*  
Richard J. Stull, *Executive Vice President, American College of Hospital Administrators*  
Edwin Whitehead, *Chairman of the Board, Technicon, Inc.*



## General Information



## Duke University

In 1839 a group of citizens from Randolph and adjacent counties in North Carolina assembled in a log schoolhouse to organize support for a local academy founded a few months earlier by Brantley York. Prompted, they said, by "no small share of philanthropy and patriotism," they espoused their belief that "ignorance and error are the banes not only of religious but also civil society which rear up an almost impregnable wall between man and happiness." The Union Institute, which they then founded, was reorganized in 1851 as Normal College to train teachers, and again in 1859 as Trinity College, a liberal arts college which in 1892 moved from the fields of Randolph County to the growing city of Durham, North Carolina. This college was selected by James B. Duke as the major recipient of a fortune when, in 1924, he provided endowment funds for the university that would bear his name.

The old Trinity College had, like almost all institutions in America at the time it was founded, been restricted to men. In 1896, Washington Duke gave an endowment with the condition that women be admitted "on equal footing with men." Thereafter women were educated in Trinity College, and in 1930 The Woman's College was established as a separate college. These coordinate colleges continued for over forty years. To assure that women were indeed admitted "on equal footing with men," and to recognize that the education which men and women had received at Duke had long taken place in the same classrooms, the University merged these coordinate colleges in 1972 to form Trinity College of Arts and Sciences, an administrative unit responsible for undergraduate admissions, programs of instruction, academic and personal counseling, and residential life. The A.B. and B.S. degrees may be earned in the College.

Instruction in engineering started at Normal College in 1851 and was continued at Trinity College as an option in the arts and sciences program. With the establishment of Duke University in 1927, the Departments of Civil and Electrical Engineering were formed, and a Department of Mechanical Engineering was added in 1931. The three engineering departments joined to form the Division of Engineering in 1937 as a separate administrative unit of the University. In 1939 this Division was renamed the College of Engineering and in 1966 it became a professional school of engineering. The Division of Biomedical Engineering was added in 1967, and it achieved departmental



status in 1971. In 1974 the name of the Mechanical Engineering Department was changed to Mechanical Engineering and Materials Science. All four departments offer courses leading to B.S.E., M.S., and Ph.D. degrees.

The School of Nursing was established in 1931 in association with the School of Medicine and Duke Hospital. The three-year curriculum led to the Diploma in Nursing, but students were required to have a minimum of one and preferably two years of acceptable college credit prior to entry into the School. Individuals completing two years of college in addition to the three-year nursing program were awarded a Bachelor of Science in Nursing degree. From 1944 until 1957 the Bachelor of Science in Nursing Education degree was offered in cooperation with the Department of Education. A four-year program leading to the degree of Bachelor of Science in Nursing was approved by the University Board of Trustees in 1953, and in 1958 a graduate program was initiated. The School of Nursing presently offers courses leading to B.S.N. and M.S.N. degrees.

As the University developed around the core of undergraduate colleges and schools, its Graduate School expanded in areas of instruction and research. The School of Law of Trinity College became the Duke University School of Law, and other professional schools were established. The Divinity School was organized in 1926, the School of Medicine in 1930, the School of Forestry in 1938, which in 1974 became the School of Forestry and Environmental Studies, and the Graduate School of Business Administration in 1969.

Duke, a privately supported, church-related (Methodist) University, has about 9,000 students enrolled in degree programs. These students annually represent nearly every state and sixty foreign countries; there are now more than 47,000 alumni in all fifty states and in many foreign countries. The University is a member of the North Carolina and Southern Associations of Colleges and Schools and of the Association of American Universities.

From academy to university some of the basic principles have remained constant. The Duke University motto, *Eruditio et Religio*, reflects a fundamental faith in the union of knowledge and religion, the advancement of learning, the defense of scholarship, the love of freedom and truth, a spirit of tolerance, and a rendering of the greatest service to the individual, the state, the nation, and the church. Through changing generations of students the objective has been to encourage each individual to achieve to the extent of his capacities an understanding and appreciation of the world in which he lives, his relationship to it, his opportunities, and his responsibilities.





## Resources of the University

**The Faculty.** The University faculty of approximately 1,200 maintains a tradition of personal attention to students. Many members of the faculty are or have been national leaders in their various professional organizations, as well as consultants to industry, government, or foundations, and their contributions to scholarship include many publications growing out of research. To honor outstanding faculty members, the University has established more than thirty James B. Duke professorships, in addition to other named professorships.

**The Libraries.** To support a rich educational experience in a world of rapid and far-reaching change, great library collections are essential. Undergraduate students at Duke are fortunate to have available exceptional resources. The University library, among the nation's twenty largest university libraries, contains 2,622,167 volumes, 4,528,964 manuscripts, and about 280,000 maps, broadsides, photographs, and materials in microtext form. Almost 14,500 periodicals and more than 200 newspapers are received currently.

A division of photographic services, with the most modern cameras and other equipment for microfilming and photographing printed and manuscript materials, provides reading machines to serve the library's large collection of microtext copies of rare books, periodicals, and newspapers. In addition to ample study space there are comfortable reading rooms for those consulting rare books, manuscripts, government publications, newspapers, and periodicals.

The East Campus Library contains 179,746 volumes in an open stack collection, chiefly those books most frequently used in the undergraduate curriculum. The School of Engineering maintains its own library, which contains 53,947 volumes and 500 periodicals. As part of the Medical Center Library, the School of Nursing Library, located in Hanes House, has reference materials including 7,000 books, current periodicals, and audiovisual aids. The School of Medicine Library contains 139,135 volumes and 2,200 current periodicals and is open to nursing students. Undergraduates also have access to additional departmental and professional school libraries.

**Computation Center.** The Duke University Computation Center provides the University faculty and students with a facility for research and instruction. The Center is presently equipped with an IBM System 370 Model 135 (320K bytes, one 3330-type disk facility, three tape drives, two card readers, two printers, and a digital plotter), which is connected by a high-speed microwave link to an IBM System 370 Model 165 (four million bytes of memory, one 2314 and two 3330-type disk facilities, seven tape drives, card reader, and printer) located at the Triangle Universities Computation Center (TUCC) in the Research Triangle Park. Also located at TUCC is a Hewlett-Packard 2000F computer, which provides BASIC interactive computing. Connected to TUCC are three medium-speed terminals (card reader and printer) located in the Engineering Building, the Biological Sciences Building, and the Sociology-Psychology Building, as well as several other low-speed keyboard terminals.

TUCC is a nonprofit corporation formed jointly by Duke University, North Carolina State University at Raleigh, and the University of North Carolina at Chapel Hill. All users of the Computation Center facilities are urged to obtain funds to pay for computer services. Any user unable to obtain grant funding may ask for financial support from his department when he applies for the services. More specific information regarding Duke computing facilities may be obtained from the Director of the Computation Center.

**Science Laboratories.** In addition to the teaching and research laboratories

in the departments of natural and social sciences and in the Schools of Engineering and Nursing, there are other facilities in which some advanced undergraduates work on individual projects. These include the Duke University Marine Laboratory in Beaufort, North Carolina; the Highlands Biological Laboratory in Highlands, North Carolina; the phytotron of the Southeastern Plant Environment Laboratories, located on the Duke campus; the Duke Forest adjacent to the campus; and the Triangle Universities Nuclear Laboratory also on the campus.

**School of Nursing Instructional Facilities.** Facilities for instruction in the School of Nursing include resources in the undergraduate college as well as in professional and graduate schools of Duke University and in the clinical facilities at Duke Hospital, Durham Veterans Administration Hospital, Lenox D. Baker Cerebral Palsy Hospital, Durham City-County Health Department, John Umstead Hospital, Johnston County Health Department, and other health agencies in the vicinity.

## **The Undergraduate College and Schools**

In Trinity College of Arts and Sciences and the Schools of Engineering and Nursing, instruction is offered by University faculty who engage in research and in graduate and undergraduate teaching. Duke offers its undergraduates the opportunity to study with many internationally recognized authorities in their disciplines, and with faculty members who are jointly committed to undergraduate instruction and to the advancement of knowledge. The University recognizes that students learn not only through formal lectures, but also through the interplay of ideas among faculty members and students; thus it offers undergraduates opportunities to test their ideas against those of their professors and to observe at close range those who have committed their lives to academic careers.

**Trinity College of Arts and Sciences.** The undergraduate liberal arts student at Duke University has many options of curricular and cocurricular programs and of residential life. The curricular offerings, the educational facilities, and the University faculty of arts and sciences provide students with a maximum opportunity for the development of special interests and talents. The cocurricular programs and activities in the residence halls reinforce the academic curriculum and provide various ways of bringing students and faculty together. Living-learning interest groups occupy some residences partially or totally. Such groups as fraternities, men's dormitories, and women's dormitories have joined in federations to sponsor academic and cocurricular programs.

**School of Engineering.** The undergraduate engineering program at Duke University is designed both for students who intend to become professional engineers and for those who desire a modern, general education based on the problems and the promises of a technological society. The environment in which students are educated is as important in shaping their future as their classroom experiences. In the Duke School of Engineering this environment has two major components: one is modern technology derived from the research and design activities of faculty and students in the School; the other is the liberal arts environment of the total University, with its humanitarian, social, and scientific emphases.

Engineering is not a homogeneous discipline; it requires many special talents. Some faculty members in the School of Engineering are designers;

they are problem-oriented, concerned with teaching students how to solve problems—how to synthesize relevant information and ideas and apply them in a creative, feasible design. Other engineering faculty members function more typically as scientists; they are method-oriented, using the techniques of their discipline in their teaching and research to investigate various natural and man-made phenomena.

Engineering students at Duke develop the facility to reason and to communicate in at least two “languages”—English and mathematics—and they learn to understand man in both a private and a social context so they can apply technology to improve the quality of life.

**School of Nursing.** The School of Nursing is committed to promoting human health and welfare by providing foundations for knowledgeable nursing services. The School aims to prepare its graduates to practice professional nursing in roles most appropriate to the level of their preparation and to provide its students with an educational background that will serve as a basis for advanced study in nursing and continued professional and personal growth.

Professional nursing practice is interacting with human beings under stress, frequently over long periods of time; providing comfort and support in times of pain, anxiety, loneliness, and helplessness; using the nursing process to make judgments in establishing, implementing, maintaining, and/or modifying a plan of health care; and knowing when and how to use existing and potential resources to help patients toward recovery and adjustment. Professional nursing practice is sharing responsibility for the health and welfare of all those in the community; participating in programs designed to prevent illness and maintain health; coordinating professional and technical services in the best interest of patient care; and supervising, teaching, and directing those who give nursing care. Professional nursing practice requires constant evaluation; asks questions and seeks answers that will add to the body of nursing knowledge; and transmits and uses this knowledge, including research findings to improve health service. Professional nursing practice requires knowledge and skill of a high order and provides opportunities for personal and professional fulfillment.

The faculty of the School of Nursing believes that the primary aim of nursing education is to provide an environment in which the student can develop self-discipline, intellectual curiosity, and the ability to think critically, and acquire knowledge and skills necessary for practice; that learning is manifested by change of behavior resulting from experience; that an atmosphere conducive to learning is offered in a climate encouraging self-direction and creativity; that the student who seeks admission to the School comes intending to practice professional nursing; and that the curriculum aids the student in realizing this intent and in stimulating the desire for continued professional growth.

### **Policy of Nondiscrimination**

Duke University does not discriminate on the basis of race, color, national and ethnic origin, or sex, in the administration of educational policies, admission policies, financial aid, employment, or any other university program or activity. It admits qualified students of any race, color, national and ethnic origin to all the rights, privileges, programs, and activities generally accorded or made available to students.





## Degree Programs



## Degrees Offered

Duke University offers in Trinity College of Arts and Sciences the degrees of Bachelor of Arts and Bachelor of Science; in the School of Engineering, the degree of Bachelor of Science in Engineering; and in the School of Nursing, the degree of Bachelor of Science in Nursing. Within the four-year curriculum of each college or school, the student has the major responsibility for designing and maintaining a course program appropriate to his or her background and goals. Each student is assisted by a faculty adviser, departmental directors of undergraduate studies, and academic deans.

Credit toward the degrees is earned in units called semester-courses (s.c.), which ordinarily consist of three to four hours of instruction each week of the semester. Double courses, half courses, and quarter courses are also recognized.

## Trinity College of Arts and Sciences

In the arts and sciences curriculum either of two programs leads to the Bachelor of Arts or Bachelor of Science degree. The programs provide a variety of approaches to a liberal arts education, and in both Program I and Program II a student may study in the following divisions of learning:

*Humanities.* Art, Classical Studies (including Greek and Latin), Comparative Literature, Drama, English, Germanic Languages and Literature, Judaic Studies, Music, Philosophy, Religion, Romance Languages (including French, Italian, Portuguese, and Spanish), and Slavic Languages and Literatures (including Russian).\*

*Natural Sciences and Mathematics.* Botany, Chemistry, Computer Science, Genetics, Geology, Marine Sciences, Mathematics, Physics, and Zoology.

*Social Sciences.* Anthropology, Canadian Studies, Economics, Education, Health Education, History, Management Sciences (including Accounting), Physical Education, Political Science, Psychology, Public Policy Studies, and Sociology.\*

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\*Black Studies, Comparative Area Studies, Linguistics, and Medieval and Renaissance Studies include courses in both humanities and the social sciences.

## PROGRAM I

Program I provides a flexible approach to the Bachelor of Arts or Bachelor of Science degree by enabling a student to choose, within broadly stated requirements, the particular subjects that best suit his intellectual interests and educational goals. The requirements, in brief, are listed below with page references to specific discussions of each.

1. The satisfactory completion of thirty-two semester-courses, including:
  - (a) at least sixteen at Duke (ordinarily including the work of the senior year);
  - (b) at least twelve at the advanced level;
  - (c) no more than four in military science; and
  - (d) no more than two with a grade of D.(See pages 10, 11, and 36.)
2. A distribution of courses among the three divisions of learning. (See page 7 and below.)

Division I: the courses of the major. (See pages 8, 9, 10, and the section on Departmental Major following each department's course descriptions.)

Division II: at least four semester-courses, including two at the advanced level. (See pages 9 and 10.)

Division III: at least two semester-courses. (See page 9.)
3. Proficiency in English composition. (See page 9.)
4. Small-group learning experiences:
  - (a) before reaching junior status
    - (1) at least one full semester-course designated as a *seminar*, *tutorial*, or *independent study*, or
    - (2) a combination of two *preceptorials* or *discussion sections*.
  - (b) junior and senior years: at least two semester-course credits for *seminars*, *tutorials*, *independent study*, or a *thesis*.(See pages 9 and 10.)
5. Quality of work: all passing grades are expected. (See pages 12-13 for minimum requirements.)

**Distribution of Courses.** The student in Program I completes at any time within eight semesters a number of semester-courses in each of the three divisions of learning (see page 7 and below). The courses in each division must be those in which the essential subject matter and substance of the discipline are presented, i.e., not skill courses. An interdepartmental course, an interdivisional course, a military science course, or a course from a professional school may not be used to satisfy distributional requirements unless it is cross-listed in an arts and sciences department. Courses offered in one division may not be used to satisfy distributional requirements in another division. Courses used to satisfy the requirements for small-group experiences may be used to satisfy distributional requirements. Courses taken on the pass/fail basis do not satisfy the distributional requirements unless offered only on a pass/fail basis. A student must complete a certain number of courses, excluding skill courses, in each of the three divisions as follows:

*First Division.* The division of the major (or concentration) is called the first division. Each student must complete requirements for a major (concentration) in a single discipline or in an interdisciplinary program. In so doing the requirement for the first division will automatically be satisfied. (See page 34.)

*Second Division.* A student must pass at least four semester-courses in a second division of his own choice. At least two of the four courses must be at the advanced level. (See page 10 regarding advanced work.)

**Third Division.** A student must pass at least two semester-courses in the third division of his choice.

### Skill Courses That Do Not Satisfy Distributional Requirements of Program I\*

Art	53-54, 56, 119
Chinese	131, 132, 133, 134
Classical Studies	Greek 1-2 Latin 1-2
Drama	101, 102, 103, 105
Education	105, 106, 107, 108, 151, 152, 161, 162, 195S, 196
English	1, 10, 50, 65S, 66S, 101S, 103S, 104S, 105S, 106S, 110, 120, 130
German	1-2, 63, 105, 181, 182
Health Education	134
Physical Education	4, 6, 7, 11, 12, 14, 15, 16, 20, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 37, 38, 39, 40, 41, 42, 43, 45, 46, 48, 50, 51, 52, 53, 60, 61, 62, 63, 65, 67, 68, 69, 70, 102, 103, 105, 106, 117, 132, 163, 164, 170, 171, 172, and 173
Hindi-Urdu	181, 182, 183, 184
Japanese	151, 152, 153, 154
Mathematics	19
Music	7-8, 65, 97, 107-108, 151, 152, Applied Music (except for tutorials)
Psychology	117
Religion	115-116, 139
Romance Languages	French 1-2, 63, 74, 76, 100, 150T, 181 Italian 1-2, 63, 74, 100 Portuguese 181 Spanish 1-2, 63, 74, 76, 100, 105, 150T, 181
Russian	1-2, 63-64
Swahili	101, 102

\*In addition, certain other courses do not satisfy distributional requirements. (See page 8.)

**Proficiency in English Composition.** Each student is required to demonstrate ability to write effective English prose either by presenting a score of 700 or higher on the College Entrance Examination Board (CEEB) English Composition Achievement Test, or by passing a course in English composition, usually in the first semester of enrollment.

**Proficiency in Foreign Language.** Certain departments recommend or require foreign language proficiency for their majors. Candidates for the B.S. degree may be required by their major departments to be proficient in a particular foreign language. (See pages 29 and 30.)

**Small-Group Learning Experiences.** By supplementing the classroom and lecture methods of instruction, small-group learning experiences assure the student opportunities to engage in discussion, develop skills, refine judgment, and defend ideas when challenged. A *seminar* (ordinarily indicated by the suffix S) is an independent course of twelve to fifteen (exceptionally to twenty) students who, together with an instructor, engage in disciplined discussion. The number of meeting hours per semester is the same as for regular courses of equivalent credit. A *discussion section* (D) is a group of approximately ten students and an instructor in which discussion is the paramount characteristic; it is an integral part of a regular course in which every member of the class is enrolled. A *preceptorial* (P) is a group of usually no more than twelve students and an instructor in which discussion is the paramount characteristic. It is an additional and optional unit attached to a regular course and in-

volves one extra meeting per week. No additional course credit is given for a preceptorial. A *tutorial (T)* is a group of one to five students and an instructor meeting for discussion independent of any other course. For *independent study* students pursue their own interests in reading, research, or writing, but are counselled by an instructor. See page 34 for procedures for enrolling in independent study. The requirements for small-group experiences are listed on page 9.

**Major (Concentration).** Although students in Program I are required to achieve breadth of intellectual experience by taking courses in each of the three divisions of learning, they are also expected to acquire some mastery of a particular discipline or interdisciplinary area. Each student will, therefore, complete a departmental major, an interdisciplinary major, or an interdepartmental concentration. (See page 34 for procedures for declaring the major or concentration.)

*Departmental Major.* A student must pass a number of courses within a department, as specified by that department, as well as courses in other departments which may be necessary or helpful for effective performance in the major. These requirements are set forth in the section following each department's course descriptions. A major consists of at least five courses beyond the introductory or basic prerequisite level in one department, but not more than eight semester-courses for the A.B. degree and not more than ten semester-courses for the B.S. degree. If desirable, the student may elect a more intensive major program. A student who completes requirements for the major in two departments may have both majors recorded on the official record. Foreign language departments may begin their major after the elementary and intermediate courses.

*Interdisciplinary Major.* A student may satisfy the requirement by completing work prescribed for a major in an approved program. These programs include Black Studies; Comparative Area Studies: Africa, Asia, Latin America; Comparative Literature; Genetics; and Medieval and Renaissance Studies.

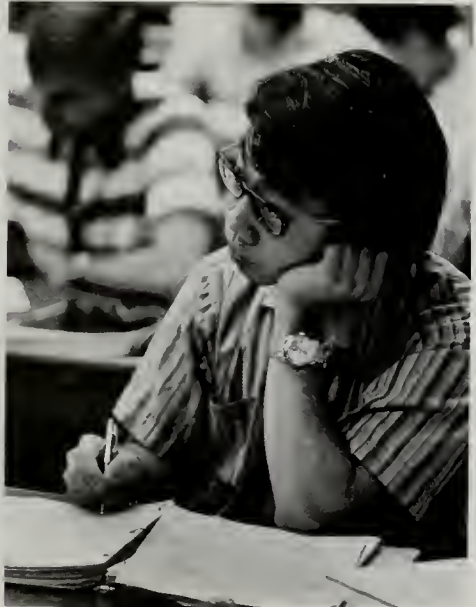
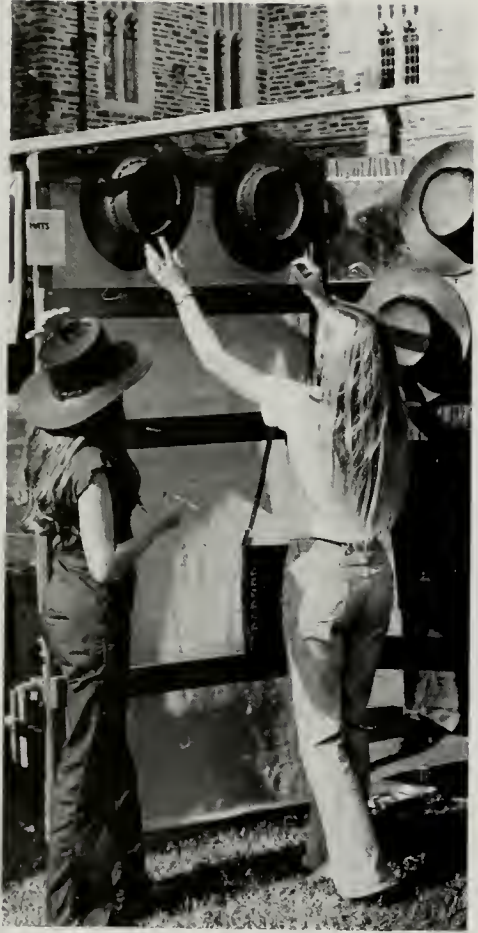
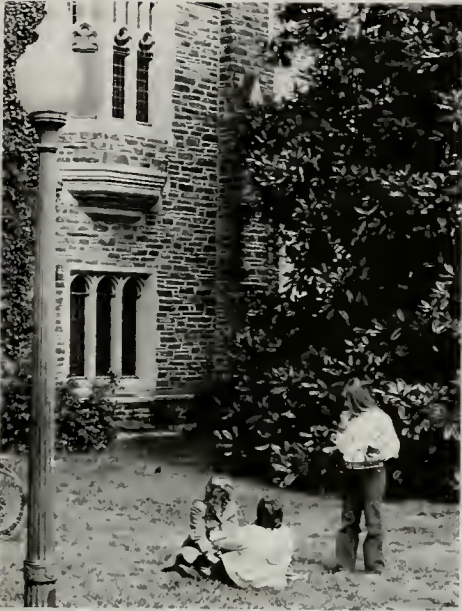
*Interdepartmental Concentration.* A student may pursue an interdepartmental major program designed by the student and advisers as an alternate means of satisfying the major requirement. An interdepartmental concentration consists of at least three courses beyond the introductory level in each of two or more departments. (See page 34 for procedures for planning an interdepartmental concentration.)

**Advanced Courses.** Of the thirty-two courses required for graduation, at least twelve must be at the advanced level, i.e., 100- and 200-series.

**Military Science Courses.** No more than four courses in the military sciences may be counted among the thirty-two courses required for graduation. These courses are normally taken in the junior and senior years. Additional courses, although not counted toward graduation, do appear on a student's permanent academic record. Military science courses do not satisfy distributional requirements.

**Residence.** A residence period of four academic years (eight semesters) is the normal amount of time a student may take to earn either the Bachelor of Arts or Bachelor of Science degree. This period may be extended for one or two semesters by a student's academic dean for legitimate reasons, and if it seems probable that an extension will enable the student to complete all remaining requirements for graduation. A student will not be permitted residence of more than five academic years, that is, ten semesters, in order to be graduated.





For the minimum residence period, at least sixteen courses must be satisfactorily completed at Duke. If only sixteen courses are taken at Duke, they must include the courses of the final two semesters. A student with more than sixteen courses at Duke may take two courses of the last year at another approved institution. A student who has completed six full semesters at Duke may take four courses in the last year at another approved institution. Courses taken elsewhere must be approved by the student's adviser and academic dean.

A former student of The Woman's College who has been out of college for six or more years may take up to ten courses or 30 semester hours of work in another institution of approved standing in final fulfillment of graduation requirements. Further information can be obtained from the Associate Dean of Trinity College of Arts and Sciences.

**Quality of Work (Continuation Requirements).** A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation each year to continue enrollment in college. A student who fails to meet the minimum requirements described below must leave college for at least two semesters. A summer session may be counted as a semester. The student may apply to the Associate Dean of Trinity College of Arts and Sciences for readmission. If, after readmission, the student again fails to meet continuation requirements, permanent dismissal will ensue.

Where continuation is in question, incomplete work in any course is considered a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the first day of classes for the spring semester, or June 10 in the summer. In the case of incomplete work in the spring semester, this requirement applies whether or not the student plans to attend one or more terms of the summer session. The student, however, may not enroll in a summer term at Duke until the requirement of satisfactory performance each semester has been satisfied.

Any student excluded from the college under the provisions of these regulations may on request have the case reviewed by the Associate Dean of Trinity College of Arts and Sciences.



*Satisfactory Performance Each Semester.* To continue from one semester to a successive semester or summer session a student is expected to achieve passing grades in all courses. In the event that one does not pass all courses the following minimum requirements must be met: after the first semester of the freshman year a student who fails more than one course must withdraw from college; a freshman who fails more than two courses in the first semester must withdraw. A student who for any special reason has been permitted to enroll for fewer than four courses must earn all passing grades, with the exception that a freshman may continue from the first to the second semester despite having earned a failing grade in one course.

*Satisfactory Progress Toward Graduation.* Each year prior to the beginning of fall semester classes, a student must have made satisfactory progress toward fulfillment of curricular requirements to be eligible to continue in the College; i.e., a certain number of courses must have been passed *at Duke* according to the following schedule:

<i>Fall or Spring Semesters Completed at Duke</i>	<i>Minimum Number of Semester-Courses Passed at Duke</i>
2	6
3	10
4	14*
5	18
6	22
7	26
8	28

Courses in the arts and sciences taken in the summer terms *at Duke* may be used to meet this requirement. No more than two courses completed with *D* grades may be counted toward fulfilling the requirements.

**PROGRAM II**

**Nature and Purpose.** Program II is an alternate approach leading to either the A.B. or B.S. degree. This program offers the student who has an unusual interest or talent in a single field, or an unusual combination of interests or talents in several fields, an opportunity to plan and carry out a special curriculum adapted to these interests and needs. The student and a departmental Program II adviser design an individual plan of work for the whole or the remainder of the student's college career. They assess background, needs, and ambitions and evaluate the resources of the University and those outside it as means of satisfying those ambitions. They consider what academic courses would be useful but also take into account that a full semester or year of independent study or work/study on or off campus, or a period of study abroad, might seem pertinent. Each curriculum is tailored to the special interests and talents of the student for whom it is designed. Topics have included Appalachian Cultural Studies, Twentieth Century Musical Composition and Conducting, Topics in Plant Physiology, and the Political Implications of Contemporary Christian Thought.

**Admission.** A student interested in Program II should confer with the director of undergraduate studies in the department closest to his or her interest.

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\*The requirement on small-group learning experiences for the freshman-sophomore years must also be fulfilled.



If the student seems eligible for Program II, the director, other adviser, or an interdepartmental committee will counsel the student concerning the design of the curriculum. When an interdepartmental committee is needed, one department will bear administrative responsibility. The curriculum must be approved by the department and also by the Committee on Program II of the Undergraduate Faculty Council of Arts and Sciences. Upon endorsement by that committee, it becomes an obligation assumed by the student, though it may later be modified with the approval of the department and the Committee on Program II. A description of the plan is sent to the student's academic dean, and each semester the student's progress in achieving the plan is also reported.

Until formally accepted into Program II, a student should register for courses to satisfy the curricular requirements of Program I. Upon acceptance into Program II, a student is relieved of most, but not all, requirements expected of Program I students. Should Program II be dropped for any reason, the student assumes all requirements of Program I.

Usually, a student will be accepted into Program II only after being in residence at Duke for one or two semesters. However, a transfer student or freshman who desires to be admitted in the first semester at Duke is invited to write the Office of Undergraduate Admissions before matriculation, providing a statement of qualifications and plans as a prospective Program II student.

**General Requirements.** Apart from the requirements arising from the approved plan of work, a Program II student must satisfy certain general requirements: thirty-two semester-course credits for graduation; the regulations on military science courses (page 10); and residence (page 10), although the requirements relating to the last two semesters may be adjusted to suit the student's approved plan of work.

## UNDERGRADUATE-PROFESSIONAL COMBINATION PROGRAMS

The Bachelor of Science or Bachelor of Arts may be awarded students who successfully complete three years in an approved curriculum in arts and sciences at Duke and also the first year of study in Duke's School of Forestry and Environmental Studies, Law School, or Medical School. After two years at Duke University and before transfer to a professional school a student may apply for the combination undergraduate-professional program through his or her academic dean. To be eligible for the combined program a student must successfully complete all baccalaureate requirements, except eight elective courses, and be admitted to the professional school. An eligible student thus registers as a first-year student in the professional school. Upon satisfactory completion in the professional school of the work of the first two semesters, or equivalent, the student will be awarded a baccalaureate degree.

## PREPARATION FOR GRADUATE AND PROFESSIONAL SCHOOLS

Students planning to enter a graduate or professional school should consult their academic dean and faculty adviser at the earliest opportunity. Since many graduate and professional schools require special tests for students seeking admission, information should also be obtained regarding the requirements from the catalogues of the relevant schools. The University Counseling Center will provide applications for the testing programs.

**Graduate Schools of Arts and Sciences.** As soon as practicable, students should ascertain the requirements of the graduate schools which they are considering and should consult an adviser in the field of the proposed advanced study. Most graduate schools have requirements in foreign languages, and



candidates for the degree of Doctor of Philosophy may be required to pass reading examinations, usually in German and French.

**Graduate Schools of Engineering.** Students interested in graduate work in engineering should consult the Dean of the School of Engineering or the director of graduate studies in one of the engineering departments. Most engineering graduate schools require that a candidate have the equivalent of a Bachelor of Science in Engineering degree; however, students in the natural and social sciences may obtain conditional admission if they have a sufficient background in mathematics and a desire to apply science to the solution of problems.

**Graduate Schools of Nursing.** Students interested in attending either graduate or post-baccalaureate programs in nursing should consult their faculty advisers, the Director of Academic Programs, or the Dean of the School of Nursing.

**Graduate Schools of Business Administration.** Students seeking advice concerning preparation for graduate school in business administration may consult the Department of Management Sciences or the College's adviser for graduate business programs. Many graduate programs in business administration are designed specifically for students with little or no undergraduate work in business. Some schools require at least one year of calculus for admission. Additional courses in mathematics can be helpful, especially linear algebra, probability, statistics, and advanced calculus. Other areas which can be of special value are philosophy of science and formal logic, one or more of the behavioral sciences, economics, the physical sciences, and engineering.

**Medical and Dental Schools.** Students planning to enter schools of medicine, dentistry, or veterinary medicine can prepare for admission by completing any of the regular departmental majors in Program I, or by Program II, and by taking those courses required by the professional schools of their choice. Virtually all medical schools and most schools of dentistry and veterinary medicine require the same basic group of college premedical courses: a year of biology, a year each of inorganic and organic chemistry, and a year of general physics. In addition, many schools require a year of English and a few require a foreign language. About a third of all medical schools now require a year of calculus and some suggest courses in statistics. For a complete listing of these and other requirements set by each medical school, see *Medical School Admissions Requirements*, published annually by the Association of American Medical Colleges. Current copies, as well as information concerning careers in dentistry, veterinary medicine, osteopathic medicine, and many allied health professions, are available in the Office of the Adviser for the Health Professions. Students should discuss their programs of study with their major adviser, academic dean, and with the Adviser for the Health Professions.

**Law Schools.** Students who plan to prepare for law school should seek breadth in their undergraduate course program with specialization in one or more areas. They may choose virtually any field for their major work. Though no specific courses are required, prelaw students have often chosen from among the following courses: Management Sciences 90; Economics 51, 52; English 55, 56; History 21, 22, 91, 92, 105, 106; Philosophy 41 and 48; Political Science 91; Sociology 91; Engineering 169, 170.

For a fuller discussion of undergraduate preparation for the study of law, students should refer to the *Bulletin of the School of Law* or consult with the College's prelaw adviser.

**Theological Schools and Religious Work.** Students contemplating theological study should correspond at the very earliest opportunity with the rele-

vant schools and with the authorities of their churches to learn how to prepare for the specific programs they expect to enter. They will likely find that they should consider the following subjects: English language and literature; history, including non-Western cultures as well as European and American; philosophy, particularly its history and its methods; natural sciences, both the physical and the life sciences; psychology, sociology, and anthropology; the fine arts and music; Biblical and modern languages; religion, both in the Judaeo-Christian and in the Near and Far Eastern traditions. Some seminaries require Greek or Hebrew for admission. It is the understanding gained in these fields rather than the total of credits or semester hours earned which is significant.

## The School of Engineering

Duke University offers in the School of Engineering programs of study which lead to the degree of Bachelor of Science in Engineering (B.S.E.) with majors in the Departments of Biomedical, Civil, and Electrical Engineering, and the Department of Mechanical Engineering and Materials Science. Special programs of study in interdisciplinary fields (see page 21) leading to the B.S.E. degree may be arranged with approval of the engineering faculty. The four curricula in the engineering departments are accredited by the Engineers' Council for Professional Development.

For graduation with a Bachelor of Science in Engineering degree, a student must complete successfully a minimum of thirty-two semester-courses. These thirty-two semester-courses must include the following:

### General Requirements

English . . . . .	1 s.c.	This requirement is met by completing English 1.
Mathematics . . . . .	4 s.c.	This requirement is met by completing Mathematics 31*, 32*, 103, and 104 or 111.
Natural Science . . . . .	3 s.c.	This requirement is met by completing Chemistry 11 and Physics 51 and 52.
Social Sciences and Humanities . . . . .	4 s.c.	This requirement is met by completion of four courses from at least two departments in the humanities and social sciences. This program of courses should reflect a rationale or fulfill an objective appropriate to the engineering profession. Courses selected must be those which present essential subject matter and substance of the discipline; for example, no introductory skill courses may be used to satisfy this requirement. Likewise, courses devoted primarily to subjects such as accounting, industrial management, finance, personnel administration, introductory language, and ROTC normally do not fulfill this objective regardless of their general value in the total engineering curriculum. House courses may not be used to satisfy this requirement.

\*Mathematics 33 and 34 are acceptable in lieu of Mathematics 31 and 32.

Engineering and  
Applied Sciences . . 4 s.c. This requirement is met by completion of at least one course from each of four of the following six areas; electrical science, information and computer science, materials science, mechanics (solid and fluid), systems analysis, and thermal science and transfer processes. See departmental requirements, which follow, for any specific courses to be included.

Digital Computation . . . . . Students are expected to have acquired digital-computer programming capability before their sophomore year. The programming capability may be satisfied by prior experience or by passing Engineering 51 or Computer Science 51.

### Departmental Requirements

Departmental  
Specifications . . . . 16 s.c. The department administering the major field of study will specify this requirement. In general it will consist of both required courses and electives to be planned in consultation with the departmental adviser. See the individual departmental requirements, which follow.

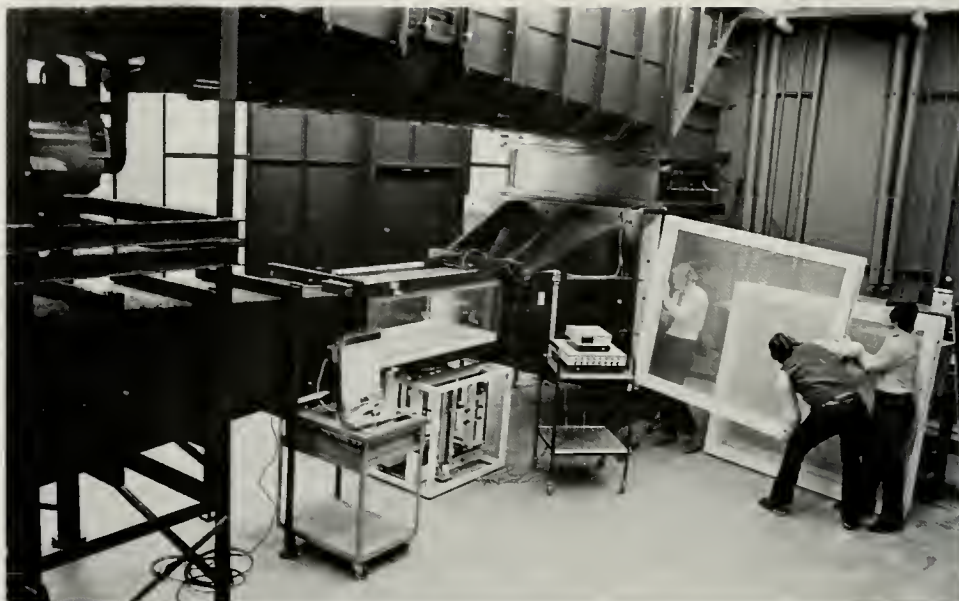
†Total Minimum  
Requirement . . . . . 32 s.c.

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†A maximum of two semester-courses of junior or senior level air science or naval science course work may be counted in satisfying the minimum requirements of thirty-two semester-courses for a baccalaureate degree in engineering. These courses must be included in the sixteen semester-courses listed under departmental requirements. All other courses completed in air science or naval science are taken in addition to the minimum program.







## Biomedical Engineering Departmental Requirements

All general requirements and departmental requirements are incorporated in the following sequence, only one of several possible sequences. The student is encouraged to choose electives and select a sequence which develops broad intellectual interests.

### Freshman Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Chemistry 11 .....	1	Chemistry 12 .....	1
English 1 .....	1	Biology 14 .....	1
Mathematics 31 .....	1	Mathematics 32 .....	1
Computer Science 51 .....	$\frac{1}{4}$	Social Science or Humanities Elective .....	$\frac{1}{4}$

### Sophomore Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Physics 51 .....	1	Physics 52 .....	1
Biomedical Engineering 111 .....	1	Biomedical Engineering 131 .....	1
Mathematics 103 .....	1	Electrical Engineering 63 .....	1
Social Science or Humanities Elective .....	$\frac{1}{4}$	Mathematics 104 .....	$\frac{1}{4}$

### Junior Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Biomedical Engineering 163 .....	1	Biomedical Engineering 164 .....	1
Biomedical Engineering 132 .....	1	Biomedical Engineering 125 .....	1
Engineering 135 .....	1	Approved Elective .....	1
Approved Elective .....	$\frac{1}{4}$	Approved Elective .....	$\frac{1}{4}$



## Senior Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Mechanical Engineering 126 .....	1	Biomedical Engineering 172 .....	1
Biology Elective .....	1	Approved Elective .....	1
Approved Elective .....	1	Approved Elective .....	1
Social Science or Humanities Elective ....	$\frac{1}{4}$	Social Science or Humanities Elective ....	$\frac{1}{4}$
			<u>4</u>

## Civil Engineering Department Requirements

The general requirements and the departmental requirements are all incorporated in the following typical program.

## Freshman Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Chemistry 11 .....	1	†Civil Engineering 16 .....	$\frac{1}{2}$
English 1 .....	1	†Engineering 11 .....	$\frac{1}{2}$
Mathematics 31 .....	1	Physics 51 .....	1
Engineering 51 .....	$\frac{1}{4}$	Mathematics 32 .....	1
		‡Approved Elective .....	$\frac{1}{4}$
			<u>4</u>

## Sophomore Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Engineering 75 .....	1	Engineering 83 .....	1
Mathematics 103 .....	1	Engineering 123 .....	1
Physics 52 .....	1	Mathematics 104 .....	1
‡Approved Elective .....	$\frac{1}{4}$	‡Approved Elective .....	$\frac{1}{4}$
			<u>4</u>

## Junior Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Civil Engineering 131 .....	1	Civil Engineering 123 .....	1
Engineering 145 .....	1	Civil Engineering 133 .....	1
*Engineering Science Elective .....	1	Civil Engineering 139 .....	1
‡Approved Elective .....	$\frac{1}{4}$	‡Approved Elective .....	$\frac{1}{4}$
			<u>4</u>

## Senior Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Civil Engineering 124 .....	1	Civil Engineering 116 .....	1
Civil Engineering 134 .....	1	‡Approved Elective .....	1
‡Approved Elective .....	1	‡Approved Elective .....	1
‡Approved Elective .....	$\frac{1}{4}$	‡Approved Elective .....	$\frac{1}{4}$
			<u>4</u>

\*Electrical Engineering 43, Engineering 72, or Engineering 104.

†May be taken in the fall or spring of the freshman or sophomore year.

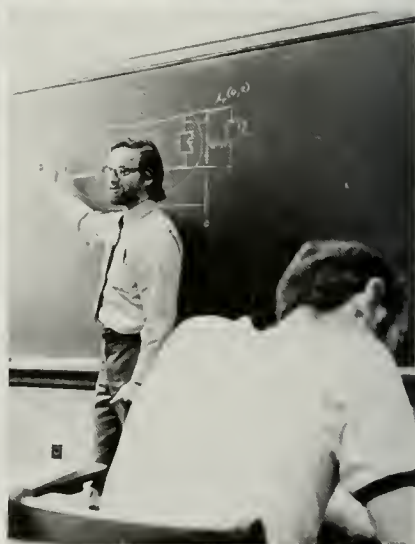
‡Part of a program of elective courses planned with departmental approval to suit the interests and abilities of the individual student. In addition to satisfying the social science-humanities requirement of the School of Engineering, the program must include a minimum of one elective course in natural science. The program should also include a minimum of three *emphasis electives* which are designed to reinforce the student's major area of study. One emphasis elective must be a civil engineering course.

Civil Engineering 133 or 134 may be replaced by an approved Civil Engineering design elective.

## Electrical Engineering Departmental Requirements\*

Mathematics .....	1 s.c.	Mathematics elective beyond Mathematics 104 or 111.
Basic Science .....	1 s.c.	Basic science elective (in addition to three s.c. in natural science listed under general requirements).
Social Sciences and Humanities* .....	2 s.c.	Social sciences-humanities elective (in addition to four s.c. listed under general requirements).
Courses in Major .....	1 s.c.	Electrical Engineering 113.
	5 s.c.	Electrical Engineering electives at the 100-level or above.
Approved Electives .....	1 s.c.	Engineering science course taught within the School of Engineering.
Approved Electives .....	2 s.c.	Engineering science, physical science, computer science, or mathematics.
Approved Electives .....	4 s.c.	
Other courses .....	15 s.c.	Listed under general requirements.

\*One of the four courses in engineering and applied sciences as listed under general requirements must be Electrical Engineering 63.



## Mechanical Engineering and Materials Science Departmental Requirements

The general requirements and departmental requirements are all incorporated in the following typical program.

### Freshman Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Chemistry 11 .....	1	*Engineering Science Elective .....	1
Engineering 51 .....	1	Mathematics 32 .....	1
English 1 .....	1	Physics 51 .....	1
Mathematics 31 .....	$\frac{1}{4}$	†Approved Elective .....	$\frac{1}{4}$

### Sophomore Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
*Engineering Science Elective .....	1	*Engineering Science Elective .....	1
Mathematics 103 .....	1	*Engineering Science Elective .....	1
Physics 52 .....	1	Mathematics 111 .....	1
†Approved Elective .....	$\frac{1}{4}$	†Approved Elective .....	$\frac{1}{4}$

### Junior Year

<i>First Semester</i>	<i>Courses</i>	<i>First Semester</i>	<i>Courses</i>
Mechanical Engineering 123 .....	1	Mechanical Engineering 136 .....	1
Mechanical Engineering 126 .....	1	Mechanical Engineering 150 .....	1
Mechanical Engineering 115 .....	1	†Approved Elective .....	1
†Approved Elective .....	$\frac{1}{4}$	†Approved Elective .....	$\frac{1}{4}$

### Senior Year

<i>First Semester</i>	<i>Courses</i>	<i>Second Semester</i>	<i>Courses</i>
Mechanical Engineering 141 .....	1	‡Advanced Technical Elective .....	1
‡Advanced Technical Elective .....	1	‡Advanced Technical Elective .....	1
‡Advanced Technical Elective .....	1	†Approved Elective .....	1
†Approved Elective .....	$\frac{1}{4}$	†Approved Elective .....	$\frac{1}{4}$

\*The four courses in engineering sciences must be Engineering 72, 75, 83, and 101.

†Part of a program of elective courses planned with departmental approval to suit the interests and abilities of the individual student. Included in these approved electives must be five social science-humanities courses and one elective course in natural science.

‡The advanced technical electives should be chosen to emphasize a professional objective in the curriculum.

The major requirements are included in the minimum total of thirty-two courses listed under the general requirements and departmental requirements. Specific courses which must be included are: Engineering 72, 75, 83, and 101; M.E. 115, 123, 126, 136, 141, and 150.

**Double Major.** If an engineering student completes the requirements of a departmental major in arts and sciences simultaneously with satisfying the requirements for a B.S.E. degree, or satisfies simultaneously the requirements

for two engineering majors, the official record will indicate this fact. However, the director of undergraduate studies for the second major must certify that its departmental major requirements have been met. The student must initiate the procedure, either through the Dean of the School of Engineering or through the director of undergraduate studies in the department, and the major requirements of the second department must be confirmed no later than the time of registration for the final semester.

Courses which are common to both majors shall be counted toward satisfying the requirements of both majors.

**Interdisciplinary Programs in Engineering.** This major parallels the majors in biomedical, civil, electrical, and mechanical engineering and materials science. It provides for special programs of study in interdisciplinary fields, such as energy conversion, engineering mechanics, materials science, ocean engineering, pollution control, systems and controls, and urban engineering, leading to the B.S.E. degree, which may be arranged with approval of the engineering faculty. Any student, in consultation with the adviser or another faculty member, may propose a unique combination of courses designed to meet particular career objectives. The proposal should be submitted to the Engineering Faculty Council, through the Dean of the School of Engineering, for approval; it may be submitted as early as the second semester of the freshman year and must be submitted before the beginning of the senior year. The proposal should include the student's reasons for pursuing the suggested program of study, and it must show how the proposed courses satisfy the following requirements:

1. The proposed program of study meets the general requirements for the B.S.E. degree but cannot be accommodated by the approved departmental requirements in biomedical, civil, electrical, or mechanical engineering and materials science.
2. A program of at least eight engineering courses is included to provide depth in the selected interdisciplinary area of study.
3. A program of at least five courses, in addition to the fifteen courses listed under general requirements, is included to provide breadth in technical (engineering, natural science, and mathematics) areas.
4. The remaining courses, which are treated as electives, require the approval of the student's adviser.

Each student enrolled in an approved interdisciplinary program will be assigned to the appropriate engineering department for administrative purposes.

**Program in Engineering and Public Policy.** Engineering students may pursue a program of study leading to the degree of Bachelor of Science in Engineering, with a major in one of the five engineering fields of study and a second major in public policy studies. The program is sponsored by the School of Engineering and the Institute of Policy Science and Public Affairs. In order to qualify for a degree with this second major, a student must satisfy the series of courses, which may be characterized as electives within the engineering curriculum, that meet the requirements for the major in public policy studies. These requirements are a modified parallel of the requirements of the major in public policy studies as described on page 211.

**Residence Requirements.** At least sixteen semester-courses must be completed satisfactorily at Duke. This must include the work of the final two semesters with the following exceptions: the student who has completed more than four full semesters of work at Duke may take the last two courses elsewhere;



others may take one last course elsewhere. The courses taken elsewhere must be approved by the student's major adviser and academic dean.

**Pass/Fail Grading Option.** With the consent of the instructor and the faculty adviser, an engineering student may choose to be graded on a pass/fail basis up to four unrestricted electives or social sciences-humanities electives within the thirty-two-course program. A student may take no more than one course on a pass/fail basis per semester.

**Continuation Requirements.** A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation to continue enrollment in the University.

A student must pass at least three courses in each semester, except for the first semester of the freshman year when at least two courses must be passed. A student who fails to meet this continuation requirement must leave the University for at least two semesters. A complete summer session may be counted as a semester. Following application for readmission, return must be approved by the dean and the director of undergraduate studies in the student's major department. If the student thereafter fails to pass three courses in a semester, permanent dismissal from the University usually results. A student who enrolls in more than four courses in a given semester and fails two or more of them will not be permitted to enroll for more than four courses in the following semester without approval of the dean. In addition, a student may be dismissed temporarily or permanently for failing to make satisfactory progress toward graduation, including satisfactory progress toward fulfillment of curricular requirements within ten semesters.

The terms *satisfactory progress* shall be defined also by the following schedule:

To begin enrollment in the	a student must have	
	passed	and earned P, C – or better in
Second year	6 s.c.	3 s.c.
Third year	13 s.c.	9 s.c.
Fourth year	20 s.c.	16 s.c.
Fifth year	27 s.c.	23 s.c.

**Grade Requirement for Graduation.** Of the thirty-two semester-courses required for graduation, twenty-eight of their equivalent in number must be passed with grades of C – or better.



# The School of Nursing

The baccalaureate program is designed to produce a professional nurse who:

1. Comprehends and appreciates opportunities, responsibilities, and relationships in a dynamic environment.
2. Develops knowledge, comprehension, and skills essential to the process of nursing.
3. Develops knowledge and comprehension of a professional role within a social, biological, and cultural framework.
4. Develops a foundation for potential social sensitivity and the desire for continuous self-development and fulfillment.

The overall goal of the curriculum is to prepare students to assume responsibilities as professional nurses and well-educated individuals. The course of study with its flexible approach prepares practitioners to function as professionals in nursing services for individuals, families, and communities.

The curriculum provides a base for professional growth; the knowledge, skills, and appreciations characteristic of those with a liberal education; and a foundation for graduate study. Studies in the freshman and sophomore years are devoted primarily to the liberal arts and basic sciences. During these years, cocurricular activities are provided to introduce the students to nursing. The focus of the junior and senior years is the nursing major. Transfer students can be readily accommodated in a curriculum of this design.

The students are seen as aggressive, active participants in making decisions about their own learning needs and interests. They are enabled and encouraged to plan a program of study compatible with their backgrounds and interests which will contribute to their personal and professional goals. With the guidance of academic advisers, students may elect courses and experiences which best serve their interests for concentration on an area of study or for exploration in several fields. Teaching techniques take into consideration the spontaneity, potential, and individuality of the student.

The distinctive features of the curriculum are:

1. Although every student acquires a base in the natural and social sciences and humanities, students may choose to develop a second major in any of these three areas.

2. The conceptual framework of the curriculum is the nursing process. Students augment, complement, and integrate social, biological, and psychological theories and experiences as they use the nursing process in the care of individuals in need of health care.

3. Through courses comprising the professional nursing component, opportunities are provided for the student to progress in uniting knowledge and decision-making with nursing action toward individuals, groups, and families whether they be hospitalized or in the community.

4. Nursing electives and independent study in the upper division permit students to pursue individual interests, to broaden their scope of nursing, and to gain a degree of proficiency in the type of initial professional practice in which they wish to engage after graduation.

5. The curriculum is theoretically oriented in the belief that students who learn to select facts and theories from relevant disciplines for application to nursing practice will be able to adapt readily to changing modalities of health care.

**Program of Study.** For graduation with a Bachelor of Science in Nursing degree a minimum of thirty-two semester-courses must be completed success-

fully. The courses are divided into lower and upper divisions with twelve upper division courses in nursing required for the nursing major.

### Lower Division

Natural Science	2 s.c.	May select from chemistry, botany, zoology, physics, geology, computer science, marine biology or biology.*
Human Ecology	2 s.c.	Nursing 97, 98
Statistics	1 s.c.	Any introductory course offered by the School of Nursing or by the Departments of Mathematics, Psychology or Economics.
Social Sciences	3 s.c.	One course must be in psychology and the other two may be: <ul style="list-style-type: none"> <li>a. one in psychology and one in sociology or anthropology</li> <li>b. two in sociology</li> <li>c. two in anthropology</li> <li>d. one in sociology and one in anthropology.</li> </ul>
Humanities	1 s.c.	No skill courses satisfy this requirement. (See page 9).
English Composition	1 s.c.	English 1 (See page 9.)
Electives	6 or 7 s.c.	

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\*Students electing Biology 11 must enroll in Biology 12.

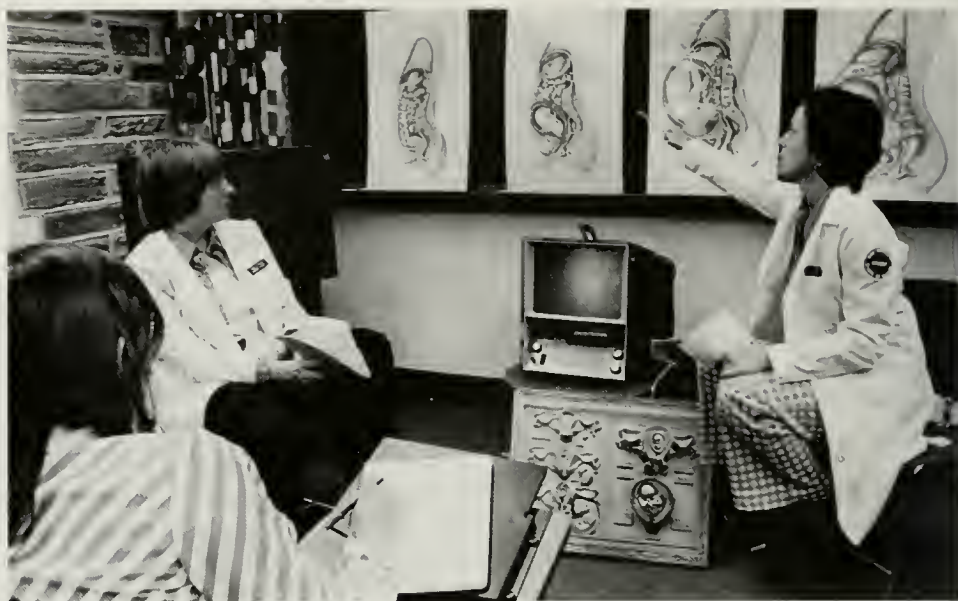
Students must satisfy the small-group learning experience requirements during the first two years, as outlined for students in the arts and sciences on page 8.

### Upper Division

Theoretic and Scientific Bases for Nursing Practice	2 s.c.
Development of Nursing Skills and Attitudes	4 s.c.
Distributive and Episodic Nursing Practice	4 s.c.
Functional Aspects of Nursing Practice	1 s.c.
Required Independent Study	1 s.c.
Electives (includes optional independent study)	4 s.c.

A student desiring to complete requirements for a second major in a department of arts and sciences may do so and have both majors entered on the official record. (See page 35.)





**Continuation Requirements.** A student must achieve a satisfactory record of academic performance each semester and make satisfactory progress toward graduation. A student who fails to meet the requirements outlined below must leave the University for at least two semesters. A summer may be counted as a semester. Following a student's application for readmission, return must be approved by the Dean of the School of Nursing. A student who is readmitted after having withdrawn voluntarily or involuntarily for academic reasons must make no grade lower than C- during the first semester in order to continue in school.

**Satisfactory Performance Each Semester.** To remain in the School of Nursing, a student must not fail three or more courses in the first semester of the fresh-



man year or fail two or more courses in any subsequent semester. An exception to this policy applies when a student fails a required nursing course worth two semester-courses.

*Satisfactory Progress toward Graduation.* A student must pass in the approved nursing curriculum at Duke the following number of semester-courses (or their equivalent in half courses or double courses) to continue from one academic year to a subsequent year. (Summer terms at *Duke* or other approved institutions may be used to meet this requirement:)

To begin enrollment in the	a student must have passed
second year	6 semester-courses
third year	14 semester-courses
fourth year	22 semester-courses
fifth year	28 semester-courses

Students are reminded that incomplete work in any course is counted as a failure to achieve satisfactory performance in that course. Such courses must be completed in time for final grades to be submitted to the Registrar no later than the day preceding the opening of the spring semester or June 15 in the summer. In the case of incomplete work in the spring semester, this requirement applies whether or not the student plans to attend one or more terms of summer session.

Any student excluded from the School of Nursing under the provisions of this regulation may upon request have his or her case reviewed by the Undergraduate Studies Committee of the School of Nursing.

A minimum of fourteen courses must be passed before a student can proceed to the upper division professional curriculum. Twelve of these courses must have been passed with a grade of C – or better. All lower division requirements must be met before entry to the upper division.

**Requirements for Degree.** To be graduated a student must pass a total of thirty-two courses (or an equivalent combination of courses, half-courses, and double-courses), including courses in the approved curriculum. Fourteen courses must be passed at the advanced level. Of the thirty-two courses required for graduation, no more than two courses with *D* grades will be accepted. Only required and elective nursing courses with a grade of C – or better will be accepted toward graduation. It is required that for graduation the student have an overall C average or better in nursing courses and that all financial obligations to the University are satisfied.

**Residence Requirements.** The requirements for the normal and maximum period of residence for students enrolled in the School of Nursing are the same as those in Trinity College of Arts and Sciences (see page 10). However, the minimum time that any student may spend in residence (full-time study) at Duke before receiving a Bachelor of Science in Nursing degree is one year unless the student is a registered nurse completing the requirements for a B.S.N. For these students full-time and part-time study are possible.

**Transportation Required.** The use of facilities other than Duke and Veterans Administration Hospitals requires transportation. It is the responsibility of each nursing student to provide a means of transportation to and from the facilities selected for learning experiences in both the junior and senior years. Although a few agencies may be within bicycling distance, most are not, and Durham's bus service is spaced at long intervals.

**Accreditation.** In addition to the accreditation status accorded the University, the School of Nursing's undergraduate program is accredited by the National League for Nursing and the North Carolina Board of Nursing.



## Academic Procedures and Information



## Advanced Placement

Scores on the tests discussed below and documented previous educational experience are the criteria used to determine a student's qualifications for certain advanced courses.

**CEEB Advanced Placement Program (APP) Examinations.** A score of 3, 4, or 5 on CEEB Advanced Placement Program Examinations is the basis for consideration for credit and placement in advanced courses in art, botany, chemistry, English,\* French, German, history, Latin, mathematics, music, physics, Spanish, and zoology. A student presenting such a score and desiring to continue in the same subject at Duke may request placement in an advanced course. In the case of French, German, Latin, and Spanish, APP scores of 3, 4, or 5 may result in placement in courses at the 100-level; approval of the director of undergraduate studies or supervisor of freshman instruction in the appropriate department is required before final placement is made. Credit may be granted for one or two courses in each subject area with the approval of the academic department concerned. A student who has earned a score of 3 must complete a specified course in that subject with a grade of C or better before credit is awarded. Pass/fail grading is *not* an option for such courses. Ordinarily, the validating course must be completed by the end of the sophomore year.

**CEEB Achievement Tests.** Scores on CEEB Achievement Tests are the basic criteria for placement in French, German, Italian, Spanish, Latin, and mathematics, and students who present a score of 700 or higher on the CEEB English Composition Achievement Test are excused from the course in English composition required for graduation. Course credit, however, is not given for courses bypassed. The following tables will assist students in making reasonable course selections in the subjects indicated.

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\*These scores, though admitting a student to advanced courses in literature, do not satisfy the requirement in composition. See section on CEEB Achievement Tests.



French‡		German		Italian	
CEEB Achievement Scores	Course Placement	CEEB Achievement Scores	Course Placement	CEEB Achievement Scores	Course Placement
200-390	French 1-2	200-360	German 1*	200-390	Italian 1-2
400-490	French 63	370-560	German 63	400-500	Italian 63
500-550	French 74, 76	570 plus	Third year†	510-550	Italian 74, 76
560 plus	French 100- level course			560 plus	Italian 100- level course

Spanish‡		Latin		Mathematics	
CEEB Achievement Scores	Course Placement	CEEB Achievement Scores	Course Placement	CEEB Achievement Scores	Course Placement
200-450	Spanish 1-2	200-520	Latin 1*	Less than 530	Math. 19
460-550	Spanish 63	530-630	Latin 63	530-800	Math. 31
560-600	Spanish 74, 76	640 plus	Third year†	760-800	Math. 31X, upon request of the student
610 plus	Spanish 100- level course			600-800	Math. 33

\*The first year of a language may *not* be taken for credit by a student who has completed more than two years of that language in secondary school. In rare cases, an exception may be granted with permission of the director of undergraduate studies in the appropriate department.

†An exception may be granted in consultation with the director of undergraduate studies.

‡In these languages students are permitted to drop back one level without loss of credit (e.g., from 101 to 74 or from 74 to 63). No credit will be allowed for courses two levels below the achievement score (e.g., students with a score of 610 in French or Spanish could not receive credit for 63, but could for 74 or 76). In no case will credit be given for 1-2 to students with three or more years of high school French or Spanish.

**CEEB College Placement Tests.** The CEEB Placement Tests in French, German, Italian, Latin, and Spanish should be taken during the orientation by (1) those students who desire to continue in the language but have not taken the CEEB Achievement Test, and by (2) those students who, having taken the CEEB Achievement Test, wish to challenge the score for the purpose of qualifying for a higher level language course. These tests are also administered at the end of each semester and at the close of the first term of the summer session for the convenience of those students who wish to demonstrate their foreign language proficiency by this means.

All freshmen who plan to take mathematics during their first semester at Duke, and who did not submit the CEEB SAT score or CEEB Achievement Test score in mathematics, must take the CEEB College Placement Test in mathematics during orientation. Students who have been placed in Mathematics 19 or 31 but believe their mathematics background justifies a higher course placement need not take the CEEB College Placement Test, but should consult the Director of Undergraduate Studies of the Department of Mathematics.

Course credit is not given for courses bypassed on the basis of the placement tests.

**Placement in Russian.** Students who wish to continue in Russian at Duke should see the Director of Undergraduate Studies in the Department of Slavic Languages and Literature. In the case of Russian, neither CEEB Achievement Test scores nor CEEB College Placement Test scores have been sufficiently validated to serve as criteria for placement. Therefore, the department offers





an examination which is used in conjunction with other criteria for placing students at the appropriate course level.

**Reading-Out of Introductory Courses.** A student demonstrating academic ability may be granted the option of "reading-out" of an introductory or pre-requisite course in order to allow him to advance at his own pace to upper-level work. No course credit may be earned by "reading-out." Reading for a course and auditing are mutually exclusive procedures. A student must be recommended for the reading option by his academic dean, and the proposed program of reading must be approved by the appropriate director of undergraduate studies. On passing a qualifying examination prepared by the department, a student may be certified for advanced course work. On completion of an advanced course, an entry will be made on his permanent record that he passed the qualifying examination, but no course credit is awarded. Further information is available from an academic dean.

**Placement in Nursing.** Registered nurses wishing to complete requirements for the Bachelor of Science in Nursing degree or students wishing to transfer nursing courses from other schools of nursing should see the Director of Academic Programs of the School of Nursing. Examinations and other criteria are used to determine appropriate placement in the approved curriculum.

**Transfer Credit.** Credit of up to sixteen semester-courses may be granted for course work satisfactorily completed at other accredited, degree-granting institutions. Courses in which grades of less than C- have been earned are not accepted for transfer credit. The semester-course credit unit awarded at Duke for satisfactorily completed courses cannot, of course, be directly equated with semester-hour or quarter-hour credits. Ordinarily, a transfer student will

not be awarded more than four semester-course credits for one semester's work unless he has satisfactorily completed more than the normal course load at the institution from which he transfers. All courses approved for transfer are listed on the student's permanent record at Duke, but grades earned are not recorded.

Courses taken at other institutions are evaluated by the University Registrar. Credit for courses in science, mathematics, and foreign language taken at a junior college may also be evaluated by the Duke departments concerned, as are some courses that have no Duke equivalents.

No credit is given for work completed by correspondence. Credit for no more than two semester-courses is allowed for extension courses.

## Advising

A student and his or her adviser confer as desired, but always before registration periods to review the student's goals, plans for achieving them, and any problems encountered or anticipated. Until declaring a major a student confers with the freshman adviser, freshman dean, or the academic dean in the division of interest. Upon declaring a major the student is assigned a departmental adviser. The academic dean for that division is also available for consultation. Much good advising is informal and occurs in conversation with members of the faculty.

## Registration

Students are expected to register at specified times for each successive semester. Prior to registration each student receives special instructions and registration materials. The student prepares a course program and presents it at an appointed time to his or her adviser for review. The approved schedule is then presented at registration.

Students who expect to teach in elementary or secondary school should consult an adviser in the Department of Education prior to each registration period to ensure that they are meeting requirements for certification (many states have unique requirements) and that they will have places reserved in the student teaching program.

Those who register late are subject to a \$25 fine. Students who fail to register are withdrawn and must apply for readmission if they wish to return; they also forfeit their \$50 registration deposits unless they indicate at the time of registration their intention not to continue in the University the following semester.

**Semester Opening.** Students are expected to report to a designated office at the beginning of each semester to obtain a semester enrollment card. Students who are unable to do so should notify their academic deans of the late arrival. Failure to report, or to account beforehand for an absence, entails a loss of registration in courses. Official enrollment is required for admission to any class.

**Course Changes After Classes Begin.** During the drop/add period changes may be made in course schedules. Course changes initiated by the student may be made free of charge during the first five days of the semester. During the remainder of the drop/add period each course change initiated by the student entails a fee of \$1.50 per change. Students are reminded that it is their responsibility to be certain that their course load conforms with the academic requirements.

In Trinity College of Arts and Sciences students may drop and add courses during the first week of classes at their own discretion. During the other week

of the drop/add period they may drop courses at their own discretion, but the signature of the appropriate instructor is required for adding courses. After the drop/add period no course may be added and in order to withdraw from a course a student must obtain permission from his or her dean. Factors to be considered by the dean include health, necessary outside work, and, up to the time midterm grades are issued, course overload. In addition, the instructor of the course from which the student withdraws must certify the student's standing in the course as satisfactory or as failing. In the former case a *WP* will be entered on the permanent record and in the latter a *WF*. Course work discontinued without approval will ordinarily result in a grade of *F*.

Within the School of Engineering and the School of Nursing the signature of the adviser is necessary for dropping or adding courses after classes begin. After the drop/add period no course may be added, and in order to withdraw from a course a student must obtain permission from his academic dean. Factors to be considered by the dean include health, necessary outside work, and, up to the time midterm grades are issued, a course overload. Until the last four weeks of class in the semester, the instructor must certify the student's standing in the course as satisfactory or as failing. In the former case a *WP* will be entered on the permanent record and in the latter a *WF*. During the last four weeks of classes in any semester, or its equivalent in the summer terms, a grade of *W* will be assigned if, in the judgment of the student's dean, compelling and extraordinary circumstances make it necessary for the student to drop the course; otherwise, the course must be continued to the end of the semester. A course discontinued without approval will result in a grade of *F*.

## Course Load and Eligibility for Courses

The normal and expected course load each semester is four semester-courses. To take fewer than four or more than five semester-courses in any semester, a student must have the approval of his or her academic dean. No student, however, may take more than six courses in any semester. With the approval of their academic adviser, seniors in the School of Nursing who need fewer than eight semester-courses may take a three-course load either semester; seniors in Trinity College and the School of Engineering need permission of the appropriate academic dean.

"Self-pacing" during a given calendar year (two regular semesters plus three Duke summer terms) is also possible with the approval of one's academic dean and faculty adviser (and in consultation with the Office of Financial Aid if the student is receiving monetary support from the University). A student may apply for one or more semesters of underload in a given calendar year after the freshman year. In every case, however, a student must meet the minimum requirements for semester to semester continuation at Duke, as well as those that apply at the end of each calendar year. Advanced placement credits and summer work taken elsewhere are excluded when minimum requirements are considered under this plan.

The rules established by the Graduate School provide that juniors and well-qualified sophomores may enroll in a 200-level (senior-graduate) course if they have obtained written consent of the instructor, as well as that of the Director of Graduate Studies of the department concerned. Within the School of Nursing 200-level courses are open only to nursing seniors and nursing graduate students. No undergraduate student may enroll in 300-level courses.

Seniors who at the beginning of a semester lack no more than three semester courses for the fulfillment of the requirement for the Bachelor of Arts or Bachelor of Science degree may enroll in graduate courses for a maximum total



program of five semester-courses. The permission of the Dean of the Graduate School is required, and admission to the Graduate School is necessary.

## **Course Audit**

With the written consent of the instructor, a full-time degree student is allowed to audit one or more courses in addition to the normal program. After the drop/add period in any semester, no student classified as an auditor in a particular course may take the course for credit, and no student taking a course for credit may change classification to an auditor. A student may not repeat for credit any course previously audited. Auditors submit no daily work, take no examinations, and receive no credit for courses.

## **Independent Study**

Independent study enables a student to pursue individual research and reading in a field of special interest subject to the supervision of a member of the faculty. (See page 10.) A student—with approval of his or her adviser, the instructor, and the director of undergraduate studies of the instructor's department—may enroll in independent study for any semester at Duke. Within the School of Nursing, the student must have the approval of her academic adviser, faculty sponsor, and the coordinator for independent study.

## **House Courses**

House courses are initiated and organized by students within given residential units. They are generally, but not necessarily, interdisciplinary in nature. If students are to earn credit for a course, it must be sponsored by a faculty member in the arts and sciences, acted upon by the department of that faculty member, and approved by the Committee on Courses of the Undergraduate Faculty Council of Arts and Sciences. Within the School of Nursing house courses are initiated and organized by students and faculty. Each house course must be approved by the Undergraduate Studies Committee and the School of Nursing Faculty. House courses may carry half-course credit. They do not fulfill distributional requirements, and no more than two semester-course credits earned in house courses may be counted toward the course requirements for graduation. Grades are submitted on a pass/fail basis. The Secretary of the Committee on Courses can provide further details for Trinity College courses.

## **Declaration of Major or Division in Trinity College of Arts and Sciences**

Each freshman must declare a division of interest (humanities, social sciences or natural sciences), or a major if desired, by registration in April of the freshman year, and all students must declare a major before the third week of the fourth semester. When a student declares a major the second and third divisions must also be identified. The form for declaring a major or division is available from academic deans and is also provided to freshmen with registration materials in the spring semester.

An interdepartmental concentration may be declared after the student confers with the directors of undergraduate studies of the departments to be involved, and they or other advisers assist the student in preparing a program of course work. The program must consist of at least three courses beyond the introductory level in each of the departments. An interdepartmental concentra-



tion must be planned early in the undergraduate career. One of the departments should be identified as primarily responsible for the student's advising. A copy of the plan for the program, with a descriptive title which will appear on the student's permanent record, should be presented along with the written approval of the directors of undergraduate studies to the appropriate academic dean. Students who declare interdepartmental concentrations must identify the second and third divisions and satisfy those requirements and all other for Program I.

A student may declare a second major to be recorded on the permanent record. A second major should be declared in the office of the student's academic dean before the student registers for the final semester. Changes in departmental majors or interdepartmental concentrations must be registered in the office of the student's academic dean. After declaring a major a student is assigned an adviser in the department of the major and an academic dean in the division of interest. Freshmen who do not declare a major, but rather a division, are advised by the academic dean in the division.

## **Class Attendance and Excused Absences**

Responsibility for class attendance rests with the individual student. Expected to attend classes regularly and punctually, the student must accept the consequences of failure to attend. An instructor may refer to the student's academic dean a student who is in his or her opinion absent excessively. As a rule, absences from required classes and tests are excused only for illnesses certified by a medical official of the University and for authorized representation of the University in out-of-town events. Officials in charge of groups representing the University are required to submit names of students to be excused to the appropriate dean's office forty-eight hours before absences are to begin.

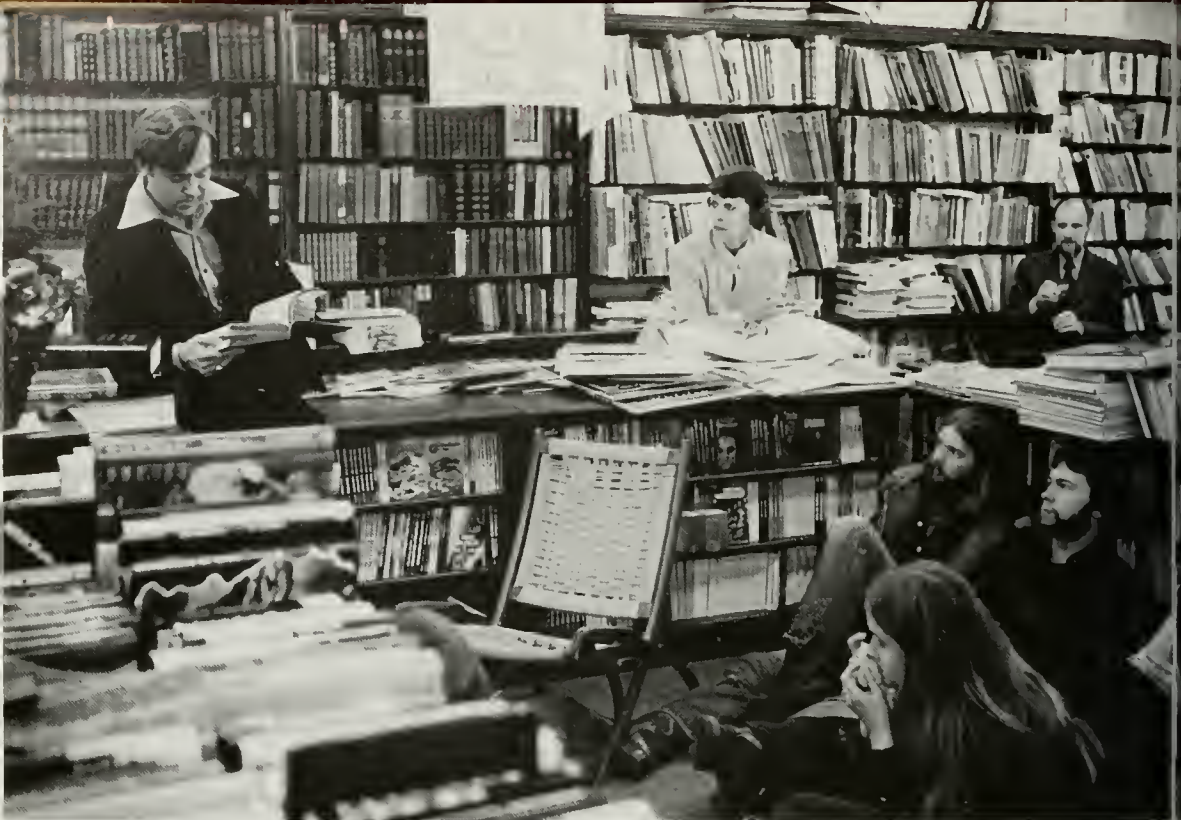
## **Final Examinations and Excused Absences**

Unless departmental policy stipulates otherwise, the conduct of the final exercise is determined by the instructor. However, a final written examination may not exceed three hours in length and a final "take home" examination may not require more than three hours in the actual writing. "Take home" examinations are due at the regularly scheduled hour of an examination based on the time period of the class. The times and places of final examinations are officially scheduled by the University Schedule Committee, generally according to the day and hour at which the course regularly meets. No changes may be made in the schedule without the approval of the Committee.

If a student is absent from a final examination, an X is given instead of a final grade. An acceptable explanation for the absence must be presented to the appropriate academic dean's office within forty-eight hours after the scheduled time of the examination or the X is converted to an F. If the absence is excused by a dean, the student arranges with the dean and the instructor for a make-up examination at the earliest possible time. An X not cleared by the end of the semester following the examination missed is converted to an F.

## **Grading and Grade Requirements**

Final grades on performance in academic work are sent to students after the examinations at the end of the fall semester. At the close of the spring semester, grades are mailed to the student's home address. Mid-semester advisory grade reports for freshmen are issued each semester.



**Passing Grades.** Passing grades are *A*, exceptional; *B*, superior; *C*, satisfactory; *P*, passing (see pass/fail option below); and *D*, low pass. These grades may be modified by a plus or minus. A *Z* may be assigned for the satisfactory completion of the first semester of a two-course sequence, and the final grade for both courses is assigned at the end of the second course of the sequence.

Although the *D* grade represents low pass, no more than two courses passed with *D* grades may be counted among the thirty-two courses required for graduation. Courses for which a *D* grade is earned, however, satisfy distributional requirements, as well as requirements in the major, English composition, and small-group experiences.

**Failing Grades.** A grade of *F* or *U* (see pass/fail option below) indicates that the student has failed the course. The grade is recorded on the student's record. If he or she registers for the course again, a second entry of the course and the new grade earned are made on the record, but the first entry is not removed.

**Pass/Fail Option.** With the consent of the instructor and faculty adviser, a student who has declared a major may choose to be graded on a pass/fail basis in one elective, non-major course each semester or summer term. In addition, with the consent of the instructor, adviser, and director of undergraduate studies, a student may take for pass/fail credit courses in independent study or internship in any department including that of the major. Certain courses are offered only on a pass/fail basis. Unless a course is offered only on a pass/fail basis, a course passed under the pass/fail option does not apply to distributional requirements.

After the drop/add period in any semester, no student may change status to or from a pass/fail basis. A pass grade may not subsequently be converted to a regular letter grade nor may the course be retaken on a regular credit basis.

**Grades When Absent from Final Examination.** (See Final Examination and Excused Absences on page 35.)

**Grade for Incomplete Work.** If because of illness or other emergency a student's work in a course is incomplete, an *I* may be received for the course instead of a final grade. Incomplete courses must be completed before the close of the succeeding semester; otherwise, the *I* is converted to an *F*. Seniors are expected to complete all courses before graduation. If student whose work is incomplete is also absent from the final examination, the student receives an *X* for the course. For the purposes of determining if a student satisfies continuation requirements, an *I* is counted as failing to achieve satisfactory performance in that course.

## Commencement

Degrees are conferred at commencement exercises in May to those who have completed requirements at the end of either regular semester of the academic year. Those who complete degree requirements at the end of a summer term become eligible to receive diplomas dated September 1, but no commencement exercises are held for such graduates, and the diplomas are mailed in December, after final approval by the Academic Council and Trustees.

## Academic Honors

To determine eligibility for academic honors, only grades earned at Duke enter into the calculation of the average.

**Dean's List.** In recognition of superior academic achievement, freshmen, sophomores, and juniors who carry a normal academic load and earn a *B* average or higher in the two semesters of an academic year are placed on the Dean's List if the following additional requirements are met:

1. Grades other than *P* have been earned in six semester-courses.
2. No incomplete or failing grade has been received within the academic year.

**Class Honors.** Students in the freshman, sophomore, and junior year who carry a normal academic load and earn a *B +* average on all work for the year are eligible for Class Honors provided the following conditions are also met:

1. Grades other than *P* have been earned in six semester-courses.
2. No incomplete or failing grade has been received within the academic year.

**Graduation Honors.** Students who earn the following averages for all work taken at Duke are graduated with honors: *B* average, *cum laude*; *B +* average, *magna cum laude*; and *A -* or above, *summa cum laude*.

**Graduation with Distinction.** Most of the academic departments have programs for graduation with distinction for students in Programs I and II and in all nursing and engineering programs. To be eligible within Programs I and II and within the engineering programs, students must show promise of achieving by the time of graduation at least a *B* average in the major field. Departments or interdepartmental honors committees may invite a student at the end of the sophomore or junior year to enter the Graduation with Distinction Program. After participation in a seminar in the junior or senior year, and/or a directed course of reading, laboratory research, or other independent study, the student must present the results of his or her individual research and study in a distinguished piece of writing. The student's achievement, including the paper, is assessed by a faculty committee, and if the student has at least a *B* average in the major field, the committee may recommend that the student be graduated



with distinction in the major field. A student engaged in an interdisciplinary program must attain an overall *B* average for courses taken in the departmental areas of concentration or special study. Achievement is assessed by an inter-departmental honors committee established by the directors of undergraduate studies in the departments concerned. An interested student should consult the director of undergraduate studies in that department. Within the School of Nursing, graduation with distinction allows the very capable student to develop critical thinking, to develop or expand knowledge in the study of a nursing problem with faculty guidance and with public recognition for demonstrated mastery. The student must present a *B +* average at the beginning of the senior year and at the end of the senior year to be eligible for graduation with distinction. Interested students should contact the coordinator for the honors program in the School of Nursing for graduation with distinction.

**Other Honors.** Election to the freshman honorary societies, Ivy and Phi Eta Sigma, of students who earn a *B +* average is made at the end of the first semester and also at the end of the freshman year. The requirements are the same as those for class honors.

Election to the national honorary society Phi Beta Kappa are held in the fall and spring; seniors are elected at both times, juniors in the spring only. Additional elections, chiefly of transfer students and doctoral students, are held in the fall following the students' graduation or the awarding of the Ph.D. Eligibility for election is determined not by the University but by the local chapter of the Society. Eligibility is based on good character and superior academic achievement. Seniors are normally considered upon the completion of six or seven semesters of work (or the equivalent), to no less than four-fifths of which letter grades have been awarded at Duke. Juniors are considered upon the completion of five semesters of exceptionally meritorious work. The total number elected usually does not exceed 8 percent of the graduating class. Inquiries may be directed to the Secretary of Phi Beta Kappa, Box 4795 Duke Station, Durham, North Carolina 27706.

Election to the national nursing honorary Sigma Theta Tau is made in the spring. Both juniors and seniors in the School of Nursing and outstanding members of the profession are elected at this time. Eligibility is determined on the basis of scholarship (students must have a *B* average), leadership, variety of outside activities, interest in nursing, and potential for excellence in the profession. Inquiries may be directed to Sigma Theta Tau, Duke University School of Nursing, Durham, North Carolina 27710.

Several prestigious fellowships for graduate study are open to applicants from Duke University. Students are selected competitively. Any student interested in these opportunities should consult the academic dean in charge of fellowships.

## Prizes and Awards

The achievements of undergraduate students are recognized in various fields of college activity. The following prizes suggest the range of the recognition.

**The Robert E. Lee Prize.** This prize is the gift of the late Reverend A. W. Plyler, of the Class of 1892, and Mrs. Plyler. The sum of \$50 is awarded annually at Commencement to the man in the senior class of Trinity College of Arts and Sciences or the School of Engineering who, in character and conduct, scholarship, athletic achievement, and a capacity for leadership, has most nearly realized the standards of the ideal student.



**Julia Dale Prize in Mathematics.** This is an annual cash prize of at least \$50. The winner is selected by the Department of Mathematics on the basis of excellence in mathematics. In some years first and second prizes are given.

**The Henry Schuman Music Prize.** A prize of \$100 is awarded annually to an undergraduate of Duke University for an original composition of chamber music or a distinguished paper in music history or analysis. The award is sponsored by Trinity College of Arts and Sciences and the Department of Music at Duke University through a continuing gift from Dr. and Mrs. James H. Semans who named the prize after Mr. Henry Schuman, a life-long friend of the Semans and Trent families, a talented amateur violinist, and one who helped to build valued collections in the Duke Library.

**The Phi Lambda Upsilon Prize.** Phi Lambda Upsilon, the honorary chemical society, annually awards a prize of \$20 to the junior chemistry major (A.B. or B.S.) having the highest overall academic average. The recipient's name is inscribed on a plaque displayed in the Chemistry Library.

**The Chemistry Department Award.** This prize is awarded annually to an outstanding chemistry major, graduating (usually) with a B.S. degree. The basis for selection is the student's scholastic record, faculty recommendations based on the student's independent research, and interest in pursuing advanced work in chemistry. The prize is a one-year subscription to an appropriate journal.

**The Merck Index Award.** This prize is awarded annually, normally to one or two graduating chemistry major(s) intending to pursue a career in medicine. Selection by a faculty committee is based on scholastic excellence. The prize consists of a copy of the Merck Index.

**The James B. Rast Memorial Award in Comparative Anatomy.** The parents of James Brailsford Rast, a member of the Class of 1958 at Duke University, endowed this award in his memory. The award, consisting of the *Atlas of Descriptive Human Anatomy* by Sobotta and bearing the James B. Rast Memorial bookplate, is given annually to the student who demonstrates the greatest achievement in the study of comparative anatomy.

**A. J. Fletcher Scholarships.** These Music Department scholarships are given to students who can demonstrate, by tape or audition, talent and achievement in instrumental or vocal performance. These awards range between \$500 and \$1,200 per annum, depending on need, and are renewable yearly for up to four years. Although recipients are not required to major in music, they are expected to study privately and to participate in departmental performing groups.

**The Winfred Quinton Holton Prize in Primary Education.** This prize was established in 1922 by gifts of Holland Holton, '07, and Mrs. Lela Young Holton, '07, in memory of their son, Winfred Quinton Holton, with the income to be used to provide a prize for investigative work in primary education. This prize of approximately \$175 may be made annually. Competition is open to Duke seniors and graduate students who are candidates for a degree in elementary education. A student who wishes to be considered for the prize must submit a paper to be judged by a faculty committee in the Department of Education. The student must first secure a faculty supervisor, and only scholarly papers which the student and faculty supervisor deem appropriate for publication should be submitted. Papers must be submitted by April 1 for consideration in a particular year.

**The Anne Flexner Memorial Award in Creative Writing.** This award has been established by the family and friends of Anne Flexner, who graduated from Duke in 1945. It consists of \$200 (first prize), \$100 (second prize), and \$50 (third prize). The awards are given annually for the best pieces of creative writing submitted by Duke undergraduates. The competition is limited to short stories (7,500-word limit), one-act plays (7,500-word limit), poetry (100-line limit), and informal essays (5,000-word limit). Only one manuscript may be submitted by a candidate, and it must be delivered to the Department of English, Room 325 Allen Building, by March 15.

**The Anne Barbour Stow Memorial Award.** This award has been established by the family and friends of Ann Barbour (Stow), who graduated from Duke in 1963, with a major in English. The stipend, approximately \$500, is awarded, usually during the senior year, to an undergraduate English major, who best fulfills those qualities which the late Mrs. Stow represented.

**The David Taggart Clark Prize in Classical Studies.** This prize is awarded to the senior major in Greek, Latin, or Classical Studies who is judged to have written the best honors essay of the year.

**The William Senhauser Prize.** Given by the mother of William Senhauser in memory of her son, a member of the Class of 1942, who lost his life in the Pacific Theater of War on August 4, 1944, this award is made annually to the student in Trinity College of Arts and Sciences or the School of Engineering who has made the greatest contribution through participation and leadership in intramural sports. The winner of this prize is chosen by a committee appointed by the President of the University.

**The Roger Alan Opel Memorial Scholarship.** A grant of \$500 is awarded annually to a Duke student who will spend an undergraduate year of academic study at a British University. The student is selected on the basis of intellectual curiosity, academic ability, and financial need. The award was established by the parents of Roger Alan Opel, a senior at Duke University who was killed in November, 1971.



**The William T. Laprade Prize in History.** This prize is offered in honor of William T. Laprade, who was a member of the Department of History at Trinity College and Duke University from 1909 to 1953, and Chairman of the Department from 1938 to 1952. It is awarded to that senior who is graduating with distinction and whose senior essay in history has been judged unusually meritorious.

**The Edward C. Horn Memorial Prize for Excellence in Zoology.** Given each year to the graduating zoology major who has shown, in the opinion of the zoology faculty, the highest level of academic achievement and promise, this prize is offered in memory of Professor Edward C. Horn. It is a tribute to his warm regard for students and faculty and his appreciation of scholarly excellence. The prize consists of books appropriate to the student's field of interest.

**The James A. Oliver Memorial Award.** This award was established in 1963 by the family of James A. Oliver and is given to the student or students who have done the most to further the interest of music at Duke University. A prize of up to \$150 is awarded annually.

**The Tau Beta Pi Prize.** This prize is awarded each year by North Carolina Gamma Chapter of Tau Beta Pi, engineering national honor society, to a sophomore student in engineering for outstanding scholastic achievement during the freshman year.

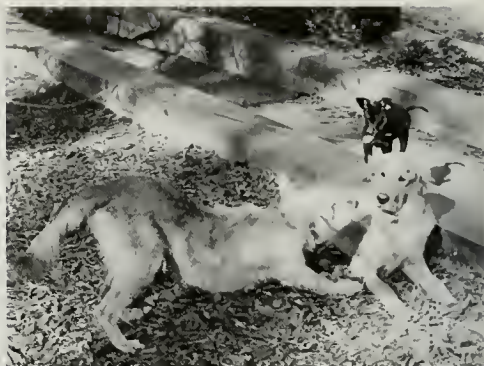
**The Walter J. Seeley Scholastic Award.** This award is presented annually by the Engineer's Student Government to that member of the graduating class of the School who has achieved the highest scholastic average in all subjects, and who has shown diligence in pursuit of an engineering education. The award was initiated to honor the spirit of academic excellence and professional diligence demonstrated by Dean Emeritus Walter J. Seeley. It is hoped that this award will serve as a symbol of the man and the ideals for which he stands. The name of the recipient is inscribed on a plaque displayed in the Engineering Building.

**The American Society of Civil Engineers Prize.** The prize is awarded annually by the North Carolina Chapter of the American Society of Civil Engineers to two outstanding civil engineering seniors, upon recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record, his contribution to the student chapter, and his participation in other college activities and organizations. The prize consists of a Certificate of Award and the payment of one year's dues in the American Society of Civil Engineers.

**The American Public Works Association Prize.** This prize is awarded annually by the North Carolina section to an outstanding senior in civil engineering upon the recommendation of the faculty of the Civil Engineering Department. The basis for selection is the student's scholastic record and his interest in a career in public works. The prize consists of a Certificate of Award, one year's payment of dues in the American Public Works Association, and a \$25 cash award.

**The George Sherrerd III Memorial Award in Electrical Engineering.** This award is presented annually to that senior student in electrical engineering who, in the opinion of the electrical engineering faculty, has attained the highest level of scholastic achievement in all subjects and has rendered significant service to the School of Engineering and the University at large. The award was established in 1958 by the parents of George Sherrerd III, a graduate of the Class of 1955, to recognize outstanding undergraduate scholarship. The recipient receives a monetary award, and the name is inscribed on a plaque displayed in the Engineering Building.





**The Charles Ernest Seager Memorial Award.** This award recognizes outstanding achievement in the annual Student Prize Paper Contest of the Duke Branch of the Institute of Electrical and Electronics Engineers or significant contributions to electrical engineering. The award, established in 1958 by the widow and friends of Charles Ernest Seager, a graduate of the Class of 1955, consists of inscribing the name of the contest winner on a plaque displayed in the Engineering Building.

**The Milmow Prize.** This prize is awarded annually to the student from North or South Carolina graduating in the Department of Electrical Engineering, who, in the opinion of the faculty of that department and, as shown by his or her grades, has made the most progress in electrical engineering during his last year in school. The prize consists of a Certificate Award and one year's payment of dues in the Institute of Electrical and Electronics Engineers for the membership year in which the honoree is awarded the baccalaureate degree.

**The Raymond C. Gaugler Award in Materials Science and Engineering.** This award is presented annually to the senior who has made the most progress at Duke in developing competence in materials science or materials engineering. The basis for selection is the student's scholastic record, research or design projects completed at Duke, and interest in a materials-related career. The award has been established by Patricia S. Pearsall in memory of her grandfather, Mr. Raymond C. Gaugler, who was President of the American Cyanamid Company prior to his death in 1952.



**The American Society of Mechanical Engineers Award.** This award is presented annually to a senior in mechanical engineering for outstanding efforts and accomplishments in behalf of the American Society of Mechanical Engineers Student Section at Duke. The award consists of a Certificate of Recognition.

**The Theodore C. Heyward Award.** Given annually to the graduating senior who has demonstrated a real interest and marked ability in the study of mechanical engineering, this award amounts to \$250. The recipient is selected by the student members of Pi Tau Sigma.

**Aaronson Scholarship Award.** Established by Dr. Pauline Gratz in memory of her husband Sidney Aaronson, this award is presented annually to the graduating nursing student who was admitted to Duke University School of Nursing as a freshman, who completed all requirements for the Bachelor of Science in Nursing degree at Duke University, and who holds the highest scholarship achievement in the graduating class on the basis of a cumulative quality point ratio. The award consists of a certificate of recognition and a cash award of \$100.

**Duke University School of Nursing Alumnae Award.** The Duke University School of Nursing Alumnae Award is presented to the student in the graduating class who has demonstrated outstanding leadership, scholarship, and nursing skill.

**The Moseley Award.** The Moseley Award of \$25 is given to the student in the senior class who has shown the most skill in the art of nursing throughout her program in the School of Nursing.

**Outstanding Service Award.** The Outstanding Service Award is presented to the student who has demonstrated outstanding service to the School of Nursing or community.

## Enrollment for the Duke Summer Session

Undergraduates of Duke University who plan to attend one or more terms of a Duke summer session or who plan to take a course in independent study during the summer should register, if possible, in the spring at the same time they register for the fall semester. Enrollment after the spring registration period may be initiated in the office of the appropriate academic dean. Undergraduates in universities or colleges outside of Duke University should apply directly to the Director of the Summer Session, Duke University, Durham, North Carolina 27706.

Distinctive features of summer session instruction are provided in the various conferences sponsored by several of the departments and by a program in marine biology offered at the Duke Marine Laboratory, Beaufort, North Carolina. See *Bulletin of the Summer Session*.

## Changes in Status

**Withdrawal and Readmission.** A student who wishes to withdraw from the University must give official notification to his or her academic dean. For students withdrawing on their own initiative prior to the Thanksgiving recess in the fall semester or prior to April 15 in the spring semester, a *W* is assigned in lieu of a regular grade for each course. Thereafter, an *F* grade is recorded for each course unless withdrawal is caused by an emergency beyond the control of the student.

Applications for readmission are made to the appropriate school or college. Each application is reviewed by officers of the school or college to which the student applies, and a decision is made on the basis of the applicant's previous

record at Duke, evidence of increasing maturity and discipline, and the degree of success attendant upon activities during the time away from Duke. Students who are readmitted usually cannot be housed on campus.

Applications for readmission must be completed by November 15 for enrollment in January, by April 1 for enrollment in the summer, and by July 1 for enrollment in September. For readmission to the School of Nursing, however, it is required that the readmission procedure be completed by February 1 for September enrollment and by November 1 for January enrollment.

**Leave of Absence.** An upperclass student in good standing may apply to his or her academic dean to take a leave of absence for one or two semesters. Applications must be submitted before December 1 for a leave of absence during the spring semester, and before July 15 for a leave of absence during the fall semester. Additional information is available from the academic deans. If granted leave, the student must keep his or her dean informed of any change of address.

Registration materials are mailed to all students on leave of absence. A student failing to register will be withdrawn from the University and will have to apply for readmission.

A student who undertakes independent study under Duke supervision and for Duke credit is not on leave of absence even if he or she studies elsewhere. The student registers at Duke as a non-resident student and pays the appropriate fees or tuition at Duke. This also applies to Duke programs conducted away from the Durham campus.

**Transfer Between Duke Schools and the College.** A student in good standing may be considered for transfer from one Duke undergraduate school or college to another upon written application and request for letter of recommendation from the academic dean. The review of a student's request to transfer will involve consideration of his or her general academic standing, citizenship record, and relative standing among the group of students applying for transfer. The school or college to which transfer is sought will give academic counseling to a student as soon as intention to apply for transfer is known, although no commitment will be implied in doing so. Students wishing to transfer to the School of Nursing for the succeeding year must complete transfer proceedings by February 1; however, openings for transfer are limited. Students seeking transfer are advised to consult the Director of Academic Programs in Nursing as early as possible.

A student may apply to transfer at any time prior to the awarding of a baccalaureate degree or after. If admitted after having earned a baccalaureate degree, he or she must undertake prescribed additional undergraduate work to qualify for a second baccalaureate degree.

**Full-Time and Part-Time Degree Status.** Ordinarily candidates for degrees are expected to enroll for a normal course load each semester. A student who needs to change from full-time status, however, or from part-time to full-time status, must consult his or her academic dean. For special reasons approved by the dean, a full-time student who is qualified to continue may register as a part-time student for no more than two courses. Part-time students may not live in the residence halls.

**Resident and Nonresident Status.** Sophomores, juniors, and seniors who wish to live off-campus may apply to the Office of the Dean of Student Affairs or, if appropriate, to the Dean of Student Affairs of the School of Nursing. (See page 56.)

**Nondegree to Degree Status.** A nondegree student must apply to the Office of Undergraduate Admissions for admission to degree candidacy.



## Study Elsewhere

**Concurrent Enrollment.** A student enrolled at Duke may not concurrently enroll in any other school or college without special permission of the appropriate academic dean. See, however, the statement regarding the reciprocal agreement with the University of North Carolina at Chapel Hill, North Carolina Central University at Durham, and North Carolina State University at Raleigh.

**Summer Schools.** Approval forms for courses to be taken at institutions other than Duke may be obtained from the offices of the academic deans. A student wishing to transfer credit for proposed summer work at another accredited college should present a summer catalog of that institution to the appropriate dean and to the director of undergraduate studies in each discipline in which he proposes to take a summer course and obtain their approval prior to taking the courses.

**Study Abroad.** A Duke student may earn up to eight course credits during an academic year for approved work completed at a foreign university or for an approved program abroad sponsored by Duke or by another American college or university. To earn the equivalent of four Duke credits each semester, the student who studies abroad will be expected to take a full course load as defined by the program or institution in which he is enrolled. Usually work to be con-



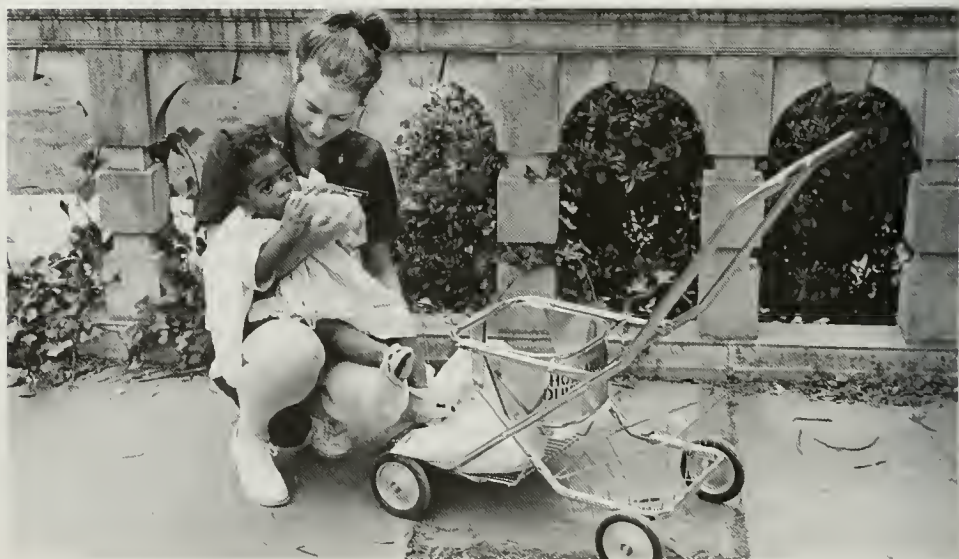
sidered for transfer credit must be done in the language in which courses are normally given at the institution attended. Duke, at present, offers several programs in cooperation with other universities. Students accepted may study at:

*Aix-en-Provence, France.* Courses are given in French language, art, philosophy, and literature. Completion of French 74, or equivalent, is required prior to departure. This program is administered through Vanderbilt University.

*Madrid, Spain.* Work is given in Spanish language, literature, art, music, and history for either the fall or spring. Completion of Spanish 74, or equivalent, is required prior to departure. This program is under the direct administration of Vanderbilt University.

*Rome, Italy.* As one of the participating members in the Intercollegiate Center for Classical Studies in Rome, Duke University nominates majors in classical studies for admission to a semester's work at the center, usually in the junior year. Instruction is offered in Greek, Latin, ancient history, ancient art, and archeology. Some scholarship help is available.

*Munich and Freiburg, Germany.* Admission to these programs entails matriculation at the University of Munich or Freiburg. The student must, therefore, meet their admission standards. Courses are taken in German language, lit-





erature, art, and history through Wayne State University, while additional courses are taken at the German universities.

*Regensburg, Germany.* The Vanderbilt Program at Regensburg is open to Duke students for either one or two semesters. Admission procedures are the same as those for the Munich and Freiburg programs.

*Warwick, England.* In the Warwick Exchange Program, selected Duke students spend a year of study at the University of Warwick, while students from Warwick study for the same period at Duke. The program is designed especially for majors in English, and it is administered jointly by Duke and the University of Warwick.

Leaves of absence from the University are granted to students who study abroad. When possible, arrangements are made for them to register while abroad for the semester in which they plan to return.

Duke University sponsors from time to time summer programs in Austria, England, France, Germany, Israel, Italy, and Spain. Students are selected competitively and have an opportunity to earn credit for two courses.

A student who wishes to transfer credit for study abroad should be guided by the following provisions established by the faculty and administered by the Committee on Study Abroad.

The student should:

1. Have a scholastic average of at least a *B-*;
2. Obtain provisional approval to study abroad from the adviser on study abroad and the director of undergraduate studies in his major department;
3. Receive certification, when applicable, from the foreign language department concerned, that he has adequate knowledge of the language of the country where he will study;
4. Obtain, *before* leaving Duke, approval for each course to be taken abroad, by the appropriate director of undergraduate studies, as well as approval of the program by the adviser on study abroad;
5. Apply for leave of absence once program plans are complete.

Information and counsel regarding study abroad may be obtained from the adviser on study abroad. In all cases he must be informed in advance about a student's plans if credit for the work is desired.

## Other Information

**Release of Student Records.** No information contained in student records (academic or otherwise) is released to non-University persons or to unauthorized persons on the campus without the consent of the student. Consent is evidenced by each student's signing a form which authorizes and limits the release of personal data. Blank forms to authorize, limit, or revise the permission are available in the offices of the Dean of Student Affairs, the Dean of Student Affairs in the School of Nursing, and the University Registrar.

**Identification Cards.** Undergraduate students are issued identification cards and semester enrollment cards which they should carry at all times. These cards are the means of identification for library privileges, University functions, or services open to them as University students. Students will be expected to present their cards on request to any University official or employee. The cards are not transferable, and fraudulent use may result in loss of student privileges or suspension. A student should report the loss of a card immediately to the Registrar's Office. The cost of a new identification card is \$5.



## Cooperative Programs



## Reciprocal Agreements with Neighboring Universities

Under a plan of cooperation between Duke University and the University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and North Carolina Central University at Durham, a student regularly enrolled in Duke University, and paying full fees, may enroll for one approved course per semester at one of the institutions in the cooperative program. If the student takes two or more courses during a summer at Duke, one of the courses may be taken at one of the neighboring institutions under this plan.

Approval forms for courses to be taken at neighboring institutions may be obtained from the offices of the academic deans at Duke. Ordinarily, only those courses not offered at Duke will be approved. The student pays any special fees required of students at the host institution, and must provide transportation.

**Judaic Studies at Duke University and the University of North Carolina at Chapel Hill.** Established in 1973 and supported by Duke University and the University of North Carolina-Chapel Hill, the Cooperative Program in Judaic Studies provides the opportunity of studying Jewish civilization through a broad range of courses including Hebrew language and literature, Yiddish language and literature, the archeology of Palestine, and the history of Jewish religious thought. The program is administered by a Joint Planning Council which also sponsors visiting speakers and professorships, library acquisitions, exchange programs with Israeli universities, summer school programs in Israel, and a publication program. Students seeking further information on the program in Judaic Studies should consult Dr. Eric Meyers or Dr. Kalman Bland in 230 Gray Building.

## Continuing Education

Residents in the Durham community who are beyond college age but have interest in resuming or beginning an undergraduate education are invited to the Office of Continuing Education for preliminary counseling. If admitted to the program in continuing education, such students may apply for degree candidacy after the satisfactory completion of four courses. Guidance seminars are offered each semester for adult women who wish to explore their





potential and evaluate community opportunities for education, employment, and non-paid involvement. Workshops in continuing education, a series of informal discussions on issues of concern to the returning student, are held throughout the year. Each semester a program of life-long learning courses for area residents is sponsored by the office. Conferences and workshops on a variety of topics are also held throughout the year. For further information consult the Director, Office of Continuing Education.

## Reserve Officer Training Corps

Through the Naval and Air Force Reserve Officer Training Programs, the University is cooperating with the Department of Defense in providing well-educated officers for the regular and reserve forces of the nation.

**The Naval Reserve Officer Training Corps.** Two basic programs through which students can qualify for Naval commissions upon graduation are offered. One, the Scholarship Naval Reserve Officer Training Corps Program, provides a maximum of four years of university study largely at government expense, followed by a commission in the regular Navy or Marine Corps. The other, the College Program, leads to a commission in the Naval Reserve or Marine Corps Reserve.

*The Scholarship Program.* Quotas are awarded on the basis of an annual nationwide test and selection procedure. Students selected are enlisted in the Naval Reserve, appointed Midshipmen, USNR, and receive four years tuition, fees, and textbooks at government expense. In addition, they receive subsistence pay and summer active duty pay which amounts to approximately \$1,300 per year. Students in the NROTC Scholarship Program are encouraged to pursue





majors in engineering (civil, electrical, or mechanical) or in specific science fields (mathematics, chemistry, physics, or computer science). Other fields of study leading to a first baccalaureate degree are permitted with the approval of the Professor of Naval Science. Students participate in two summer training cruises aboard ship and receive aviation, amphibious, surface, and submarine indoctrination at Naval shore stations for one summer.

Upon graduation, the student receives a commission as Ensign in the Regular Navy, or Second Lieutenant in the Regular Marine Corps, after which he serves with the Navy or Marine Corps as required by the Secretary of the Navy in the same manner as graduates of the Naval Academy. The minimum period of active duty is four years for regular officers.

*The College Program.* The College Program student is selected from regularly enrolled freshmen in Duke University who desire to qualify for a commission in the Naval or Marine Corps Reserve while pursuing normal courses of study. Upon graduation, he will normally be ordered to three years of active duty. He has the status of a civilian who has entered into a mutual contract with the Navy, and he is not eligible for the benefits and pay received by Scholarship Program Midshipmen. He enlists in a component of the Naval Reserve and receives subsistence pay of \$100 a month during his last two academic years. In addition, he receives active duty pay (about \$300) during the one required summer cruise. This cruise normally occurs during the summer between the student's junior and senior years.

*Scholarship and College Program Students.* No distinction is made between students in the two programs in the NROTC Unit. College Program students may compete each year for the Scholarship Program. If selected, they will be appointed to scholarship status with the attendant benefits and pay. Students in both programs are provided necessary uniforms, equipment, and Naval

Science textbooks; both are furnished the same instruction, and both are required to wear uniforms on drill days and upon special occasions prescribed by the Professor of Naval Science. Upon completion of their undergraduate work, both may apply for continuing studies leading to a graduate degree. If he desires, a student in either program may elect the Marine Corps option at the beginning of his junior year, thus qualifying for a commission in the Marine Corps. Both may participate in a Navy sponsored Flight Instruction Program leading to qualification for a private pilot's license upon successful completion of the program.

*Academic Requirements for a Commission.* The academic program for an approved degree and a commission for Scholarship and College Program students must include all Naval Science courses offered and the following:

For NROTC scholarship students, one year of calculus, one year of physics, and Computer Science 51 (or equivalent) are to be completed by the end of the junior year. History 149, Management Science 70 and Political Science 121, 122, or 157 are to be completed prior to graduation.

For NROTC College Program students, courses are not required in calculus, physics, or computer science, but students are strongly recommended to complete these courses in view of their career value, military or otherwise. Completion of these courses will receive consideration in the awarding of scholarships by the Professor of Naval Science. History 149, Management Science 70, and Political Science 121, 122, or 157 are to be completed prior to graduation. Marine option students in their junior and senior years will take two relevant courses, approved by the Professor of Naval Science and taught by University faculty members.



**The Air Force Reserve Officers Training Corps (AFROTC).** This unit functions as the Department of Aerospace Studies. It selects, trains, and commissions college men and women who desire to serve in the United States Air Force. Two AFROTC programs exist, a four-year and a two-year program.

The four-year program consists of two segments, one covering the freshman and sophomore years which includes general military courses, and the other covering the junior and senior years which includes professional officer courses. These two segments are linked by a four-week summer field training encampment at selected Air Force bases. Entry into the four-year program is open to freshmen and to sophomores who are willing to make up the course work missed due to late entry into the program. For sophomores this amounts to taking both the freshman and sophomore courses in one year.

Applications for the two-year program should be submitted no later than the spring semester of the sophomore year. Candidates attend a six-week field-training encampment following their sophomore year, which concentrates on the course work missed during the freshman and sophomore years.

Cadets may compete for a scholarship if they so desire; freshmen for a three-year scholarship to begin with the sophomore year; sophomores for a two-year scholarship to begin with the junior year. Candidates for the two-year program may compete for a scholarship during the six-week summer encampment. Scholarships cover full tuition, cost of all required books, certain fees, as well as a stipend of \$100 per month. Regardless of scholarships, all cadets receive a tax free stipend of \$100 per month (limited to \$2,000) during their junior and senior years.

A four-year active service plus two-year reserve commitment is incurred upon entry into the Professional Officer segment of the AFROTC Program. For details on entry and commissioning requirements, contact the office of Aerospace Studies.

**Army and Navy Nurse Corps Student Program.** Students in the School of Nursing may apply for appointments in the Army Student Nurse Program at the beginning of their junior year, or in the Navy Nurse Corps Candidate Program at the beginning of their senior year. The appointments carry a generous financial allowance. A student who participates for twelve months or less serves on active duty in the respective service for twenty-four months. If support for two years has been given, thirty-six months of active duty are required.





Student Life





## Residential Facilities

It is the aim of the University to provide through its residential program convenient and comfortable lodging that features opportunities for informal learning and the enrichment of the total educational experience. The living units are designed to foster an intellectual atmosphere, to stimulate interest in cultural and cocurricular activities, and to provide opportunities for interaction with faculty, staff, and students from other parts of the country.

Freshman students are required to live in University residences unless they live with parents or close relatives. Housing on campus, however, is not normally available to transfer students, to former students who have been readmitted, or to part-time students. Students beyond the normal fourth year of the undergraduate program cannot be guaranteed space in the dormitories.

**Residences for Undergraduate Students.** Many students in Trinity College of Arts and Sciences and in the School of Engineering live in residences on the East and West Campuses and in the furnished Central Campus Apartments. Some residences are reserved for all women's groups comprised of members of all four classes; others for all men's groups comprised of members of all four classes. There are also fraternities located in campus residences. In some houses men and women are assigned to separate wings or floors of the same house. Another option exists in living-learning houses or corridors where students who qualify by application are brought together because of special interests. The living-learning situations generally are filled by upperclassmen.

Many residential units are members of federations. A federation is a cluster of separate residences, usually including two houses for men and two houses for women, joined together under a faculty fellow and federation government for common academic and social programs. There are also all freshman men's houses on West Campus which accommodate approximately one-half of the freshman men. Each of these houses elects its own officers and council and organizes social, intramural, and other programs. After the freshman year students who do not affiliate with a social fraternity may choose from among the seventeen independent houses.

Nursing students live in Hanes House and Hanes Annex. Entering students may request a double or a single room but returning students have first choice of rooms. After the initial assignment students arrange for room selection

and roommates through the Office of the Dean of Student Affairs in Nursing. Resident house counselors who are on the staff of the Dean of Student Affairs live in the dormitories and are responsible, with the cooperation of the student government, for the administration of the residential units.

**Living Off-Campus.** Students above the freshman level who wish to live off-campus should apply for such authorization from the appropriate dean of student affairs. Once nonresident status is approved no guarantee can be made of a space in the dormitories should the student desire to move back on campus.

If a resident student marries while enrolled and plans to move off-campus, a written request for a change to nonresidency must be submitted with the statement of marriage to the Dean of Student Affairs. (In the School of Nursing, a letter from the parents or guardian to the Dean indicating knowledge of the forthcoming marriage must be received prior to the marriage.)

## Dining Facilities

**The East Campus.** All students residing on the East Campus are required to contract for their meals in the University Dining Halls on a semester basis. First semester freshmen must take the seven-day plan. Second semester freshmen and all upperclassmen have the option of a seven-day, twenty-one meals a week plan, or a five-day (Monday-Friday) fifteen meals plan. (See chapter on Financial Information.) There are no provisions for changing plans during the semester. On the East Campus there are two dining halls; ordinarily, the students who reside in Southgate, Jarvis, and Gilbert-Addoms take their meals in Gilbert-Addoms; those in other East Campus dormitories take their meals in the East Campus Union. Due to the large number of students served by the dining halls, it is not possible to provide special diets.

**The West Campus and Graduate Center.** The dining facilities on West Campus include two cafeterias with multiple-choice menus, the Oak Room which is a service dining hall where full meals and *a la carte* items are served, and a self-service snack bar, the Cambridge Inn, which is open throughout the day and evening. The Graduate Center has a public cafeteria and a Coffee Lounge, which is open until 12:00 midnight.

Freshmen in the School of Nursing are required to contract for their meals in the University Dining Halls on a semester basis. Their options are the same as those offered to students residing on the East Campus.

## Religious Life

Two symbols indicate the importance of the religious dimension for Duke University: *Eruditio et Religio*, the motto emblazoned on the seal of the University, and the location of the Duke Chapel at the center of the campus. Persons from all segments of the University and the surrounding community come together in Duke Chapel on Sunday morning to worship in a service which offers excellence in liturgy, music, and preaching. The University ministers work with the chaplains from the Roman Catholic, Protestant, and Jewish communities to provide a ministry which is responsive to the plurality of University religious interests. The traditional modes of ministry—pastoral, priestly, and prophetic inquiry—are offered in traditional and contemporary forms.

A student can find opportunity within the University community to search for meaning, to ask the ultimate questions, to worship in small communities, to meditate, to participate in contemporary liturgies, to learn from outstanding thinkers in the religious traditions, and to work to bring about a more just and humane society.

## Services Available

**Offices in Each College and School.** In Trinity College of Arts and Sciences, in the School of Engineering, and in the School of Nursing, deans, faculty members, and counselors are readily available to discuss various concerns with students and to assist them in matters relating to courses, majors, careers, cocurricular activities, life styles, residential matters, etc. Each college and school has its own academic deans and advisers. In Trinity College of Arts and Sciences, there are academic deans for freshmen as well as academic deans for upperclassmen according to the student's declared major or academic division. In the School of Nursing, each student is assigned an academic adviser for the freshman and for each succeeding year.

The School of Nursing has its own Dean of Student Affairs, whereas the Office of the Dean of Student Affairs appertains to students in both Trinity College of Arts and Sciences and the School of Engineering. The Office of Black Affairs relates to the needs of all black students at Duke.

**Student Health Service.** The aim of the Student Health Service is to provide medical care and health advice to students. Both the Student Health Services Clinic and the University Infirmary are available to students for that purpose. The University Health Program is currently being evaluated in terms of costs and coverage; therefore, beginning with the 1976-77 academic year a separate fee for this service may have to be assessed.

The facilities of the Student Health Services Clinic are open during both regular and summer sessions to all currently enrolled full-time undergraduate students as well as to regularly enrolled students in the graduate and professional schools. For treatment of illnesses or injuries, students should first visit the Student Health Clinic. The campus bus makes regular runs to the clinic, and emergency transportation can be obtained from either the Duke Campus Police or the Durham Ambulance Service. Residential staff personnel should be consulted whenever possible for assistance in obtaining emergency treatment. For a description of the specific services provided by the clinic and infirmary, see the *Bulletin of Information and Regulations*.





In addition to the Student Health Service, the University provides for a plan of Accident and Sickness Insurance to cover all full-time students who are enrolled in the University. This plan is designed to complement services normally not available to students through the Student Health Service coverage and covers students both on and off campus, at home, or while traveling between home and school during the interim vacation periods throughout the one year of the policy.

**The University Counseling Center.** The University Counseling Center provides services designed to assist individuals in gaining a better understanding of themselves and of the opportunities available to them. The professional counselors do not attempt to impose solutions on the individual, but provide help in developing more effective problem-solving skills. The following are some of the areas in which counseling services are offered: choosing a career, planning programs leading to careers, identifying and overcoming educational deficiencies, developing greater self-understanding, and developing more effective social relationships.

The Counseling Center has available a wide variety of tests which may be employed in the counseling process. These tests provide measurements of general ability, scholastic aptitude, special skills, vocational interests, and levels of adjustment. In the process of counseling, the counselee may, with the help of the counselor, choose those tests that may provide information needed to make decisions. Counseling is confidential between the counselor and student.

**The Office of Black Affairs.** Through contact with students and participation on administrative staffs and committees within the university, the Office of Black Affairs seeks to create and maintain an atmosphere that is congenial to black students. The focus of the office is upon the student. Counsel and advice is given for academic matters, social concerns, and personal problems. A large percentage of the time is spent interpreting the nature of the environment and student reactions to it, in an attempt to allay anxieties and undo frustrations that, when left unattended, lead to academic difficulties.

For the education experience to be successful for black students, provisions must be made for them to interrelate the way of life that nurtured them prior to their coming to Duke with the experience they have and the expectations they will develop while here. To this end, the office helps students interact with the larger community through attending local churches and participating in various social and political activities in the community. The office also coordinates social, religious, and cultural activities on campus, such as the Gospel Choir, and the Dance Group.

**Office of Placement Services.** The Office of Placement Services is the liaison between the University community and potential employers in business, education, and government. The purpose of the office is to help Duke students plan career directions and obtain employment commensurate with their qualifications, interests, and desires. An extensive file of openings for permanent, part-time, and summer employment is available, as well as a library of general information about careers, employers, and graduate schools. Interviews with staff members are available at any time to all Duke students to discuss career plans, permanent and part-time employment opportunities, interviewing techniques, and other related matters.

*Post-College.* Students nearing the completion of a degree, who are interested in interviews with representatives from business and industry, schools and colleges, government agencies, and graduate schools should register with the office in September. Representatives and recruiters begin coming to Duke on October 1.



*Part-time Employment.* A listing of a wide variety of part-time job opportunities on the campus and in the Durham area is maintained in the office. All students interested in working during the school year should register at the beginning of the semester. Every effort will be made to help each student find a job consistent with career interests.

*Career Counseling.* Preliminary exploration of career interests early in the student's academic career is available with the Career Counselor and through the Career Apprenticeship Program which offers non-paid experience in a variety of career fields. It gives the student the opportunity to gain practical work experience and to enlarge the educational experience by related field work during the undergraduate years.

## Judicial System and Regulations

Duke University expects and requires of all its students full cooperation in developing and maintaining high standards of scholarship and conduct. Each student is subject to the rules and regulations of the University currently in effect or which are put into effect from time to time by the appropriate authorities of the University. At the same time, the individual is responsible for decisions and choices within the framework of the regulations of the community as Duke does not assume *in loco parentis* relationships.

Any student, in accepting admission, indicates his willingness to subscribe to and be governed by these rules and regulations. He acknowledges the right of the University to take disciplinary action, including suspension or expulsion, for failure to abide by the regulations or for other conduct adjudged unsatisfactory or detrimental to the University.

Responsibility for prescribing and enforcing rules and regulations governing student conduct rests ultimately with the Board of Trustees of Duke University and, by delegation, with administrative officers of the University and of the schools and college. In the undergraduate units, as well as the University as a whole, many of these rules have been established over the years by cooperative action between students and administrative officers and, in the case of some rules, with participation of faculty members as well. Representative student organizations, such as student governments and judicial boards, and more recently, community-wide bodies of students, faculty, and administrators, have initiated proposals for policies and rules necessary to assure satisfactory standards in academic and nonacademic conduct. These proposals have been accepted by University officers and have become a substantial, if not all-inclusive, body of rules governing student life at Duke. For current regulations, the *Bulletin of Information and Regulations* should be consulted.

Students in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing constitute an undergraduate community whose members are subject to the Undergraduate Community Code. Violations of the code and certain University regulations are adjudicated before the Undergraduate Judicial Board, composed of representatives of the student body, the faculty, and the administration. The constitution of the Board, the Judicial Code of the Undergraduate Community, and the procedural safeguards, and rights of appeal guaranteed to students are published in the *Bulletin of Information and Regulations* for the undergraduate college and schools. As provided under the judicial structure of the University, each residential unit has a Judicial Board which has jurisdiction over all offenses involving violations of regulations relating to dormitory procedures and social regulations not covered by the Undergraduate Community Code or University policies and regulations. The Judicial Board of the Student Government Association of the School of



Nursing (NSGA) has the major role in supervising phases of community living which directly concern the welfare of the students in the School of Nursing.

## Student Activities

**Office of Student Activities.** The Office of Student Activities has as its responsibility the coordination of those activities, undergraduate and graduate, that transcend the individual college and schools with a major emphasis on the development of the full range of these activities as they relate to the educational function of the University. In addition, this office is responsible for giving financial advice in cooperation with the Controller's office.

**Associated Students of Duke University.** The Associated Students of Duke University (ASDU), composed of representatives of each of the undergraduate living groups on campus and representatives of students living off campus, is responsible for the articulation of student thought and opinion on University-wide matters and for the shaping of student opinion toward constructive changes in the educational process and University environment. The working philosophy of ASDU is that students have the right to make those decisions which primarily affect students.

The ASDU Legislature is composed of representatives of each of the undergraduate living groups on the campus, representatives of students living off

campus, and of representatives from among the transfer students. It primarily fulfills an administrative role, chartering student organizations, regulating student elections, and certain aspects regarding conduct. ASDU also attempts, as a student voice, to discern problems of primary concern to the student body and to take positive action in those areas. Third, it tries to identify subtle aspects of decision-making which underlie these problems and to focus student attention on these issues.

The Executive Cabinet is the coordinating body of all ASDU functions. It consists of the President, four Vice-Presidents (two from Trinity College of Arts and Sciences and one each from the School of Engineering and the School of Nursing), an Executive Secretary, an Administrative Secretary, and other members as appointed by the President. Various executive committees of ASDU undertake projects for the direct benefit of the student body, such as those concerned with residential life, academic affairs, and admissions. A budget commission allocates all student fees to the various student organizations.

**Cultural and Social Organizations.** The scope of the more than one-hundred student organizations is suggested by a partial listing of the following activities: Association of African Students, Alpha Phi Omega service fraternity, Bridge Club, Chess Club, Campus Crusade for Christ, Cheerleaders, International Club, Karate Club, Outing Club, Sailing Club, Students for a Democratic Society, Women's Liberation, Young Americans for Freedom, and the YM-YWCA. Sixteen national and three local social fraternities, as well as eight social sororities, are represented on campus and governed by Interfraternity and Pan-Hellenic Councils.

Many opportunities are provided on campus in the area of music and drama. The Duke Chorale, the Chapel Choir and Chancel Singers, the Wind Symphony, Pep Band, Symphony Orchestra, and Collegium Musicum are examples of musical activities. Duke Players perform established and experimental drama; Hoof 'n' Horn presents musical comedy.

Most academic departments sponsor organizations and programs for students with special academic or professional interests. There are also academic and leadership honorary societies.

The Union Building, located on the West Campus, is the center for student activities. It houses, among other groups, the University Union which brings students together in carrying out its stated purpose—to stimulate, promote, and develop the social, recreational, cultural, educational, and spiritual activities of the Duke University community. The Union sponsors a broad program including lectures, concerts, recreational activities, dances, and exhibits adapted to the leisure time interests and needs of individuals and diverse groups within the University and Durham communities.

In one section of the West Campus Union are housed dining facilities, University store, grill, beer hall, soda fountain, post office, barber shop, bank, and ballroom. Elsewhere in the building are student organization offices, meeting rooms, an information center, music and reading lounge, and recreational areas. Similar services and activity areas are provided on the East Campus.

**Office of Cultural Affairs.** The Office of Cultural Affairs is responsible for the coordination of many of the cultural and popular entertainments which take place on the campus. The office is directly responsible for the Duke Artists Series and Quadrangle Pictures (35mm film program) and the scheduling and use of Page Auditorium. Advance tickets for most events scheduled in Page Auditorium are sold at Page Box Office. The Office of Cultural Affairs also publishes yearly and weekly editions of the *Duke University Calendar*.

**Media.** The *Duke Chronicle*, the campus newspaper, is published five times



weekly, and the student-operated FM and companion AM radio station, WDBS, produces daily programs. Three magazines and a comprehensive yearbook are published by students for all students. These publications are under the direction of a Publications Board empowered to choose the editors and business managers and to review and approve the financial statements of all franchised publications. The *DukeEngineer* is the official student-published magazine of the School of Engineering. It appears twice each semester and contains articles on technical and semi-technical topics and other matters of interest to the School. *The Charge* is the student undergraduate handbook of the School of Nursing which is published by students annually. It contains information and regulations which pertain to students within the School of Nursing.

**Recreational Activities and Intramurals.** The Duke recreation and intramural programs provide all students an opportunity to participate in some form of informal and competitive physical activity.

The men's program consists of seventeen different activities which include archery, bowling, cross country, golf, handball, horseshoes, tennis, flag football, badminton, paddle ball, basketball, swimming, table tennis, volleyball, wrestling, softball, and track. In a typical year more than 3,000 students compete for the many intramural titles and trophies that are awarded. Each year Duke, North Carolina, North Carolina State, and Wake Forest meet in the annual Big Four Intramural Day.

The women's program encompasses competition in badminton, basketball, bowling, tennis, and volleyball. In addition, special events in other areas of interest are conducted, and various clubs including modern dance, water ballet, and other sports offer the student opportunities to take part in extracurricular activities.





Through coed intramurals, the student is encouraged to participate on a less competitive level promoting relaxed social as well as physical activity. Opportunities for coed competition are provided in the areas of badminton, table tennis, tennis, and volleyball. Numerous other activities are being planned.

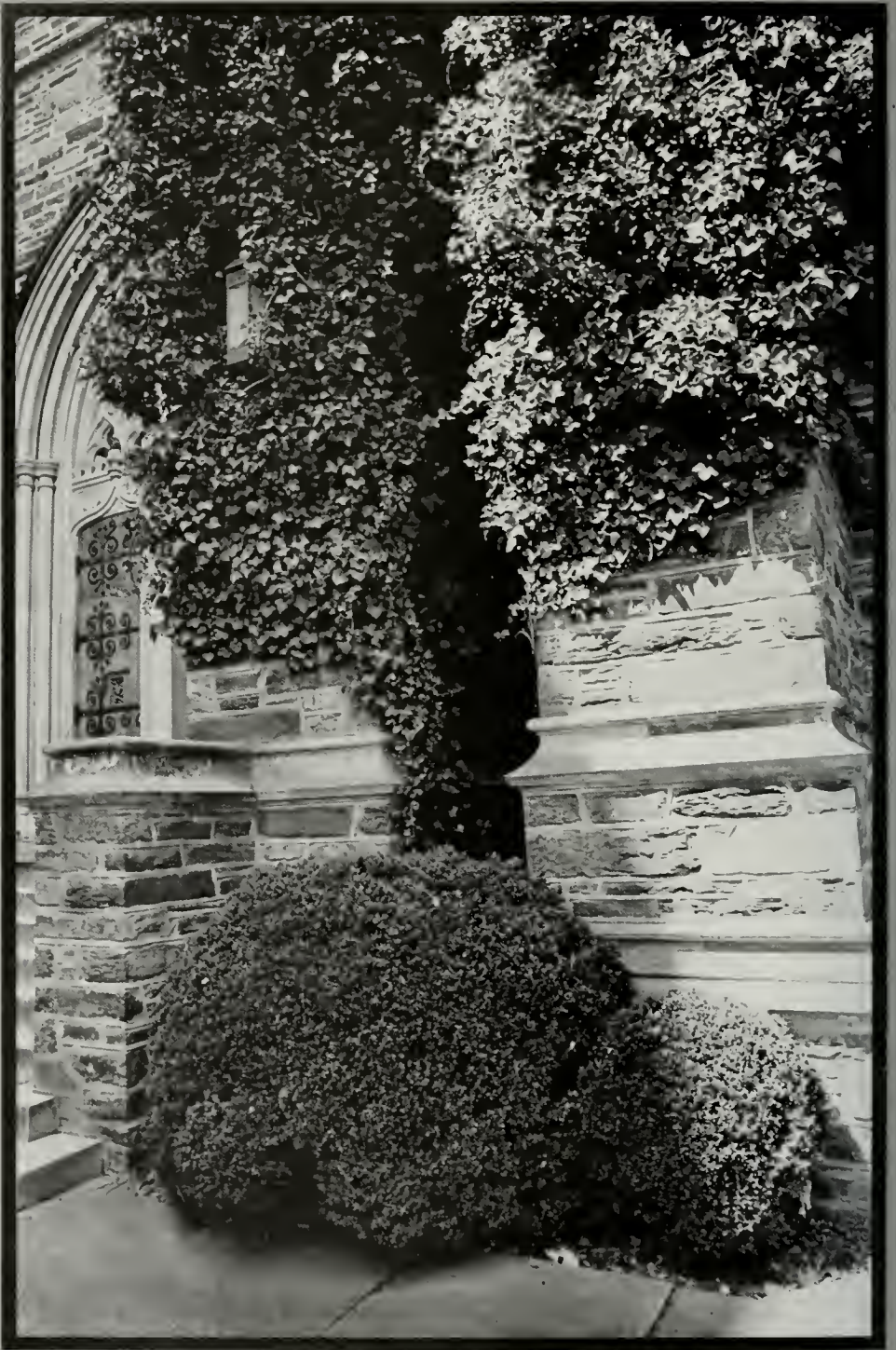
The University's varied athletic and recreational facilities and equipment are available for use by the students. The facilities for recreation include a golf course, lighted tennis courts, three swimming pools, a student activities building, three gymnasiums, outdoor handball and basketball courts, an all-weather track, and numerous playing fields and informal recreational areas. A variety of clubs dealing with archery, gymnastics, scuba diving, sailing, cycling, badminton, karate, rugby, soccer, and other activities are available to interested students.

**Intercollegiate Athletics.** Duke is a member of the National Collegiate Athletic Association, the National Association of Intercollegiate Athletics for Women, and the Atlantic Coast Conference (ACC). The ACC consists of Clemson, Duke, Maryland, North Carolina, North Carolina State, Virginia, and Wake Forest.

The intercollegiate program for men at Duke University offers thirteen varsity sports. They are football, cross country, soccer, basketball, swimming, fencing, wrestling, indoor and outdoor track, baseball, golf, tennis, and lacrosse. Freshmen are eligible to participate on all varsity teams. Junior varsity programs are provided in football and basketball.

The women's athletic program, also a function of the department of athletics, provides intercollegiate competition in eight sports: basketball, fencing, golf, gymnastics, field hockey, swimming, tennis, and volleyball. The teams are coached by members of the athletics department or other appropriately trained personnel. Several of the women's sports have junior varsity programs.

The director of athletics provides departmental leadership and coordinates all athletic policies with the University Athletic Council. The Council consists of representatives from the undergraduate student body, the faculty, the administrative staff, and the alumni. They meet with the director of athletics periodically during the school year to discuss the athletic programs and make recommendations concerning athletic policies. The chairman of the Council is appointed by the president of the University and he is the official University representative at national and conference athletic meetings. The women's program is directed by a coordinator who serves under the leadership of the athletic director.



Admission



## Principles of Selection

James B. Duke, in establishing his Indenture of Trust, requested that "great care and discrimination be exercised in admitting as students only those whose previous record shows a character, determination, and application evincing a wholesome and real ambition for life." In this light and in view of the institution's limited enrollment, Duke University looks beyond the basic characteristics of academic competence possessed by the majority of applicants. It seeks in each prospective student, regardless of race, sex, color, religion, or national origin, evidence not only of intellectual promise and maturity of judgment, but also a degree of positive energy. Often, this energy is expressed in the form of special talents and accomplishments, but is consistently seen in a student's determination to make creative use of the opportunities and challenges posed by Duke University.

## Requirements for Application

Although there are no inflexible subject matter requirements, students are urged to formulate a high school program of breadth and challenge. At least twelve units of acceptable college preparatory work must be presented for review. Applicants for the School of Engineering are advised to take four units of mathematics and at least one unit in physics or chemistry.

The Scholastic Aptitude Test given by the College Entrance Examination Board and three Achievement Tests (one of which must be in English composition) are required of all candidates for freshman admission and must be taken before the application deadline. Since placement in language study can be determined by an achievement test score, it is recommended that a candidate who expects to continue study in a foreign language take the CEEB Achievement Test in that language. Although the above mentioned CEEB test battery is preferred, candidates may submit results of the American College Testing Assessment Program (ACT) provided the test is taken prior to the application deadline and available to the Admissions Committee thirty days before the decision date. Candidates for the School of Engineering, who elect to take the CEEB test battery, are required to take the Achievement Test in Mathematics.



## Application Procedures

Application forms and a *Bulletin of Information for Prospective Students* may be obtained from the Office of Undergraduate Admissions, Duke University, Durham, North Carolina 27706. A non-refundable processing fee of \$20 must accompany the completed application form.

A personal interview at Duke is not required for admission; students who find it possible to visit the campus, however, may write for an interview or participate in one of the group information sessions held during particularly busy periods. Interviews cannot be guaranteed during the early months of the calendar year when applications are under review.

**April Notification.** Candidates for admission to the freshman class must apply no later than February 1 of their senior year in secondary school and normally do so during the preceding autumn. Decisions are mailed from the University by April 15, and accepted candidates are expected to reserve a place in the class by May 1.

**February Notification.** The student who indicates on his application that he wishes to learn his admission decision by February 1 of his senior year must observe a December 15 application deadline. Results of the Scholastic Aptitude Test and achievement tests (or the ACT) taken through December may be submitted for review. Applicants for February notification are urged to apply concurrently to other colleges, although those who are accepted by Duke in February must pay the registration and room deposit fees by February 15 in order to reserve a place in the class. Because neither of the two notification dates is designed to be more competitive than the other, students who receive negative decisions in February should not request that their applications be reviewed once again in April.





**Midyear Admission.** Midyear admission allows a limited number of freshmen to begin their college work a semester early or to postpone matriculation for a semester. Midyear applicants are expected to complete all the requirements set forth for fall admission. The application deadline for new candidates is October 15; students will be notified of the decision on their applications by November 15 with the expectation that those who are accepted will reply by December 1.

**Admission by Transfer.** Admission by transfer from other accredited institutions may be arranged for a limited number of students each semester. Because the transcript of at least a full year of academic work is preferred by the Admissions Committee and because transfer students are required to spend their last two years at Duke, most candidates apply to Duke during their third or fourth semester in college. Candidates submit official transcripts of all work completed at other accredited colleges, scores on the Scholastic Aptitude Test, and employment records if there has been an extended period of employment since graduation from secondary school. See page 31 concerning evaluation of transfer credit.

All transfer students should expect to be responsible for their own housing arrangements. The Office of Housing Management provides assistance to students who seek housing and/or roommates.

September transfers observe the February 1 application deadline, learn of their decisions by April 15, and respond to the University by May 1. January transfers apply by October 15, learn of their decisions by November 15, and reply to the University by December 1. Transfer students for the School of Nursing are accepted for September admission only, and must complete all transfer application processes by February 1.

**Nondegree Students.** A few individuals are permitted to enroll as non-degree students in most of the courses open to degree students, but under no circumstances can places in courses be preempted for them. These students are given academic and career counseling by the Office of Continuing Education and are subject to most of the regulations set forth for degree candidates. Nondegree applications may be obtained from the Office of Undergraduate Admissions and should be submitted to that office, accompanied by a \$20 application fee, by July 15 for the fall semester and by December 1 for the spring semester.

At least four courses must be completed successfully before a nondegree candidate may apply for degree candidacy. Students who plan to complete the four courses should not expect automatic admission to the University. More detailed information is available from the Office of Continuing Education, 107 Bivins Building, Duke University, Durham, North Carolina 27708.

**Readmission of Former Students.** A student who desires to return, following withdrawal from college, should apply to the appropriate college or school. See page 43 for readmission procedures and dates. Students who have been withdrawn from the University for five or more years must submit a new application to the Director of Undergraduate Admissions.



## Financial Information

## Tuition and Fees

No college or university can honestly state that an education at the college level is inexpensive. Yet fees paid by students cover less than half the cost of their instruction and the operation of the University. Income from endowment and contributions from alumni and other concerned individuals meet the balance and assure each student the opportunity to pursue an education of unusually high quality.

Students are urged to give their attention first to the selection of institutions which meet their intellectual and personal needs, and then to the devising of a sound plan for meeting the cost, including a knowledge of the University's financial aid program, as well as their family's own resources. A brochure describing in detail the various forms of financial aid may be obtained from the Office of Financial Aid, Duke University, Durham, North Carolina 27706.

**Estimated Expenses for an Academic Year.\*** Certain basic expenditures such as tuition, room, and board are to be considered in preparing a student's budget. These necessary expenditures, with a reasonable amount allotted for miscellaneous items, are shown below:

Tuition	\$3,230†
Residential Fee	
Single room	\$845-\$1010
Double room	\$630-\$745
Food	
Seven-day board plan	\$913
Five-day board plan	\$785
Cafeteria estimate	\$980
Books and Supplies	\$220

It should be realized that additional expenses will be incurred which will depend to a large extent upon the tastes and habits of the individual. The average Duke student, however, can plan on a budget of \$5,500 for the academic year. Travel costs, clothing purchases, and other major expenditures would have to be added to this estimate.

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\*These figures contained in this section are projected and are subject to change prior to the beginning of the fall 1976 semester.

†For juniors and seniors in the School of Nursing, the tuition is \$3,430.

**Debts.** No records are released, and no student is considered by the faculty as a candidate for graduation until he or she has settled with the Bursar for all indebtedness. Bills may be sent to parents or guardians provided the Bursar has been requested in writing to do so. Failure to pay bills on or before the due dates will bar the student from class attendance until the account is settled in full.

**Tuition.** The tuition charge per semester (see p. 69) is due and payable not later than the day preceding the first day of classes for a particular semester.

**Registration Fees and Deposits.** On notification of acceptance, students are required to pay a nonrefundable first registration fee of \$20 and to make a deposit of \$100. The deposit will not be refunded to accepted applicants who fail to matriculate. For those who do matriculate, \$50 of the deposit serves as a continuing room deposit for successive semesters, and the remaining \$50 serves as a continuing registration deposit.

*Late Registration.* Continuing students who fail to register in the registration period must pay to the Bursar a fee of \$25.

*ROTC Deposit.* An Air Force ROTC deposit of \$10 is required of students enrolling in air science to cover possible loss of military equipment issued to them. This deposit is refunded to the student upon return of issued equipment.

*School of Nursing.* Special nonrefundable laboratory and health fees are charged as follows: sophomores—\$30; juniors—\$25; seniors—\$30. The health portion of this fee is not a student health insurance fee, but a charge which covers laboratory tests and a physical examination for students at their entry and exit points of clinical experience. These physical examinations must be conducted at Duke University. A declaration of satisfactory health is required by the School for personal protection of the student, by affiliating clinical agencies, and for nurse registration applications at completion of the program. The laboratory portion of the fee includes the cost of a stethoscope in addition to other items. Additional medical fees may be required for certain nursing electives.

*Part-Time Students.* In the regular academic year students who register for no more than two courses in a semester are classified as part-time students. Part-time students will be charged at the following rates: One course, \$323; half course, \$161.50; quarter course, \$80.75; one course plus laboratory or precept, \$430.67. Registration for more than two courses requires payment of full tuition. Graduate students registered for undergraduate courses will be assessed three units for non-laboratory courses and four units for laboratory courses. Nondegree men and women students beyond usual college age who are on review for admission to degree programs, as designated by the Office of Continuing Education, pay fees by the course whether the course load is one, two, or three courses.

*Auditors.* Auditing of one or more courses without charge is allowed students paying full fees, provided that the consent of the instructor is obtained. Students who are enrolled for one or two courses may audit other courses by payment of \$40 for each course audited. With the consent of the appropriate instructor and the Director of Continuing Education, graduates of Duke may audit undergraduate courses for \$40 per course.

*Duke Employees.* Full-time employees with one or more years of service with the University may request permission to take for credit or audit up to two courses during any one semester. Permission may be granted based on the individual merits and circumstances of each application. Employees receiving permission to take such courses for credit will be charged one-half of the tuition rate for part-time students as shown above. Courses may be audited upon pay-



ment of \$40 per course. Employees are required to submit a formal application by December 1 or July 15.

**Fees for Course Changes and Transcripts.** Changes in registration for courses for reasons not arising within the University require a payment of \$1.50 for each change made. Requests for transcripts of academic records should be directed to the Office of the Registrar. Ten days should be allowed for processing. A minimum fee of \$2, payable in advance, is charged for a single copy. A charge of fifty cents will be made for each additional copy on the same order to the same address.

## Living Expenses\*

**Housing.** In the residence houses for undergraduate students other than nursing students, the residential fee for a single room ranges from \$845 to \$1,010 for the academic year; for a double room, the fee ranges from \$630 to \$745 per occupant. In the Graduate Center, the residential fee for a single room is \$695 for the academic year; for a double room, it is \$520 for each occupant.

The residential units of the School of Nursing are Hanes House and Hanes Annex. The residential fee for a single room is \$930 for the academic year; for a double room, it is \$695 for each occupant.

To reserve University housing for the fall semester, returning students who are eligible for, and wish to occupy, such housing must make a \$50 prepayment of the housing fee at a designated time during the spring semester.

Detailed information concerning the student's obligations under the housing contract and the consequences of failure to comply are published in the *Bulletin of Information and Regulations*.

**Food Services.** See Food Services on page 56 for a description of dining facilities on both campuses and the options or requirements for board contracts. The charge for board is \$456.50 per semester on the seven-day plan or \$393 per semester on the five-day plan, payable at the time of registration.

## Refunds

In the case of withdrawal from the University the student or the parents may elect to have tuition, as well as room and board (if applicable), held as credit for later study, or refunded according to the following schedule:

<i>Withdrawal</i>	<i>Refund</i>	<i>;</i>
Before classes begin	Full amount	
During first or second week	80%	
During third, fourth, or fifth week	60%	
During sixth week	20%	
After sixth week	None	

In the event of death, or involuntary withdrawal to enter the armed services, refunds will be made on a pro-rata basis.

The \$50 registration deposit will be refunded to students (1) whom the University does not permit to return, (2) who graduate, or (3) who request the refund prior to registration, thus indicating their intention not to return for the following semester. The registration deposit will not be refunded to students who register but fail to enter the following semester on schedule.

Arrangements for refund of the \$50 room deposit are described in information furnished each student by the Housing Bureau.

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\*The figures contained in this section are projected and are subject to change prior to the beginning of the fall 1976 semester.

## Student Aid

It is the policy of Duke University to provide adequate financial aid for all students when evidence of need exists. The amount of financial assistance approved for an individual varies directly with his financial need. Degree of need is determined according to widely accepted principles recommended by the College Scholarship Service.

For the student with demonstrated need, the net cost of an education at Duke University will generally be no greater than that for college attendance at a private institution elsewhere. It is the intention of the Financial Aid Office to set each award at a level which will enable a student to meet all the costs of attending Duke University, taking into consideration the contribution that can reasonably be expected from the student, his family, and any available outside sources. During the current academic year, approximately one-third of the student body received more than three million dollars in scholarships or loan funds.

**Financial Aid for Entering Freshmen.** Candidates should initiate their application for financial aid concurrently with their application for admission during the fall semester of their senior year in secondary school. Instructions concerning the specific requirements and deadline dates will accompany application materials. The Parents' Confidential Statement must be submitted to the College Scholarship Service. This form may be obtained either from a high school guidance counselor or from the Financial Aid Office. A certified copy of the parents' current Federal Income Tax Form 1040 must also be submitted.

A student in residence who is receiving financial assistance based upon need may not register an automobile on campus during the academic year for which the aid is granted without special permission for an appropriate reason.

**Renewal of Financial Aid after Freshman Year.** Each year students must file an application for renewal of financial aid. This application must include a new Parents' Confidential Statement and a certified copy of the parents' current Federal Income Tax Form 1040.

In order for financial aid to be renewed, a student must be in good academic standing with the University. A. B. Duke and J. A. Jones Scholars are expected to maintain considerably higher than a minimum average.

**Types of Financial Aid.** Gift scholarships or grants, long-term loans, and employment are integral parts of the financial aid program, and some portion of the aid offered an undergraduate will normally be in each of these forms. In 1975-76, the self-help portion consisted of an \$800 loan and a job paying \$700. Acceptance of a gift scholarship does not require the student to undertake the loan or job portions of his award. Duke has several scholarships based on need which are available from personal endowments and corporation sources. Some are designed for entering freshmen, whereas others are awarded to upperclassmen. These scholarships may be based upon achievement in a particular field or an overall outstanding record.

**Gift Scholarships.** The following are among the named gift scholarships offered through Duke University:

*Angier B. Duke Memorial Scholarships.* Recipients of these awards are students whose superior records mark them as young men and women who give outstanding promise of becoming leaders in their chosen fields of endeavor. Candidates for admission to the freshman classes in Trinity College of Arts and Sciences, the School of Engineering, and the School of Nursing are eligible to



apply. Forty are usually available for each freshman class with a value of \$500 to \$4,300 annually, depending upon financial need.

*W. N. Reynolds Memorial Scholarships.* Recipients of these awards are students of outstanding ability and need who have made superior records and show promise of constructive leadership. In considering candidates for the awards, consideration will be given in the following order:

1. Children of employees of R. J. Reynolds Tobacco Company or any of its affiliates or subsidiaries.
2. Children of families residing in Forsyth County, North Carolina.
3. Other candidates who are residents or natives of North Carolina.

Number available: four of each freshman class.

Value: \$500 to \$4,300 annually.

*United Methodist Scholarships.* A number of United Methodist Scholarships, valued at \$500 per year, are available on a basis of demonstrated need to Methodist students who have given evidence of leadership in their local Methodist Youth Fellowship Groups.

*Alice M. Baldwin Scholarships.* One or more of these scholarships, varying in amount from \$200 to \$2,000, are awarded to rising seniors in Trinity College of Arts and Sciences on the basis of scholarship, character, and leadership.

*Evelyn Barnes Memorial Scholarship.* One \$400 or two \$200 grants are awarded to undergraduate women who are contributing to the musical life of the University. Scholarship, character, and leadership are considered. Recommendation by a member of the music faculty is required.

*Panhellenic Scholarship.* A scholarship of approximately \$500 is awarded to an upperclass woman in Trinity College of Arts and Sciences on the basis of scholarship, character, leadership, and service.



*Delta Delta Delta Scholarship.* A scholarship of \$200 is awarded by Delta Delta Delta to an undergraduate woman on the basis of scholarship and character. The winner of this award is eligible to compete for the national award of a Delta Delta Delta Scholarship of \$1,000.

*Sandals Scholarship.* A scholarship of approximately \$200 is awarded to a rising sophomore woman in Trinity College of Arts and Sciences, on the basis of scholarship, character, leadership, and potential for contributions to the University community.

*Welch Harriss Scholarships.* These awards are made to male freshmen who have achieved outstanding academic records and who demonstrate financial need. They are renewable each year as long as the student remains in good academic standing. Consideration will be given in the following order: (1) student from High Point; (2) students from Guilford County, North Carolina; and (3) students from North Carolina. Number available: three for each freshman class.

*Florence K. Wilson Scholarships.* Grants-in-aid are made each year from the Florence K. Wilson Scholarship Fund to nursing students qualifying for financial assistance. This fund was established in 1961 by combining the School of Nursing's Alumnae Association Fund, the students' Florence K. Wilson Scholarship Fund, and contributions from the Wilson family and friends.

*Alyse Smith Cooper Scholarships.* Each year six or more scholarships of various amounts are awarded to students demonstrating both talent and need. Preference is given to students from Alamance County, North Carolina. Especially considered are majors in music and art, particularly students of piano, organ, and voice.

*Braxton Craven Endowed Scholarships.* Scholarships up to the amount of tuition are awarded to outstanding students, with first preference given to Davidson County, North Carolina, residents and second preference to students from North Carolina. The scholarships are approved on a continuing basis, providing satisfactory academic progress is achieved.

*Marian Sanford Sealy Scholarship Fund.* Established in 1966 with an initial gift from the Durham-Orange County Medical Auxiliary, the Marian Sanford Sealy Scholarship is awarded to a student indicating financial need. Personal qualifications supportive of potential to become an outstanding nurse and a distinguished academic record are the criteria for the awarding of this scholarship.

*Lelia R. Clark Scholarship in Nursing.* The Duke Hospital Auxiliary established the Lelia R. Clark Scholarship in Nursing in 1971 to cover tuition and fees for a nursing student, preferably one from North Carolina. Prerequisites for the award are a commendable academic record, financial need, and exemplification of the qualities of a person committed to serving others.

*Federal Nursing Grants.* Funds provided by the federal government are available in limited amounts for grant awards to qualified nursing students.

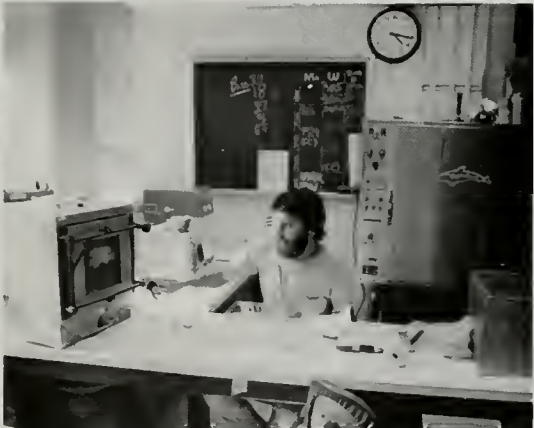
*J. A. Jones Memorial Scholarships.* The scholarships, sponsored through the Jones Fund for Engineering, are awarded to engineering students whose outstanding academic and personal qualifications suggest that they will become leaders in a technological society. The awards range from a yearly sum of \$500 to \$3,600, depending on the degree of need.

*Robert H. Pinnix Scholarships.* The Robert H. Pinnix Scholarships are awarded annually to two upperclassmen enrolled in the Duke School of Engineering. The award is based upon demonstrated ability, excellence in engineering, and financial need.



*Scholarships for Foreign Students.* A limited number of awards will be made each year to qualified students from other countries who enter either as freshmen or as students with advanced standing. Candidates for these awards are required to submit the Application for Scholarship and Financial Aid and the Parents' Confidential Statement of the College Scholarship Service provided by the Admissions Office of Duke University. Two named awards bring foreign students to the campus: the Carol Cranmer Scholarship (named for a former student) and the Roberta Florence Brinkley International Scholarship (named for a former dean).

*The Mary Duke Biddle Scholarship in Music Composition.* This scholarship with a stipend of \$2,500 per year is available to a member of each entering class. It is renewable from year to year so long as the student does satisfactory work. Students wishing to apply for this award will be required to submit examples of their composition. Eligibility is limited to students planning to major in music.



*AFROTC College Scholarship Program.* Students can apply for three-year scholarships during their freshman year and two-year scholarships during their sophomore year. Scholarships are available to male students who qualify for flight training and to both male and female students who major in certain scientific or engineering fields. The scholarships include tuition, fees, and text book reimbursement plus a \$100 per month tax free allowance.

*NROTC College Scholarship Program.* This program provides for up to four years' tuition and textbooks, laboratory fees, and a \$100 per month stipend. These scholarships can be awarded at any stage of the student's college career through either a nationwide selection basis or by the Professor of Naval Science at the local level based upon academic achievement, leadership potential, and overall performance. In addition, two other two-year scholarships are available to rising juniors; one leading to a career in nuclear power and the other follows a summer attendance at the Naval Science Institute at Newport, Rhode Island. For further information on any of the above scholarship programs, contact the Professor of Naval Science.

*North Carolina Legislation Tuition Grant.* The North Carolina General Assembly established a program of tuition grants available to North Carolina residents who are full-time students at in-state private colleges and universities. The grant for each eligible student is \$200.

*The Minnie Happer Pruden Scholarships.* The scholarships are available to the daughters of Episcopal clergymen.

*The Huguenot Scholarship.* A scholarship of \$1,000 per year is available from the Huguenot Society of America to a descendant of a Huguenot.

**Loans.** The loan programs which are available to students through Duke University are listed below:

*National Direct Student Loan Program.* Loan funds supplied by the federal government through Part E of Title IV of the Higher Education Act of 1965 are available to qualified students. Repayment of loans under this act normally begins nine months after the student graduates or leaves college, with complete payment scheduled within a ten year period. Interest accrues at the rate of three percent annually commencing nine months after the borrower ceases to be a full-time student at an institution of higher education. This loan is part of the student's financial aid award.

*Nursing Loans.* Loan funds supplied by the federal government are available to qualified students in the School of Nursing. Interest accrues at the rate of three percent annually commencing nine months after the student ceases to be a full-time student. A certain percentage of the loan is forgiven for each year the student serves as a professional nurse. This loan is part of the nursing student's financial aid award.

*Federal Guaranteed Insured Loan Program.* Under the Higher Education Act of 1965 Congress established the Federal Guaranteed Insured Loan Program, designed to guarantee and insure student loans. These loans are made by banks or other incorporated state lending agencies, with enrollment of the student certified by the school or college. The interest is seven percent. Students who qualify will have the interest paid by the government while they are in school. Duke University is a guaranteed lender.

**Remission of Tuition.** Children of ministers in the North Carolina and the Western North Carolina Annual Conferences of the United Methodist Church may be eligible to receive a partial tuition grant of \$1,500 for a maximum of eight semesters of undergraduate study at Duke University. Eligibility is met by the parent being in a regular pastoral appointment and resident in one of

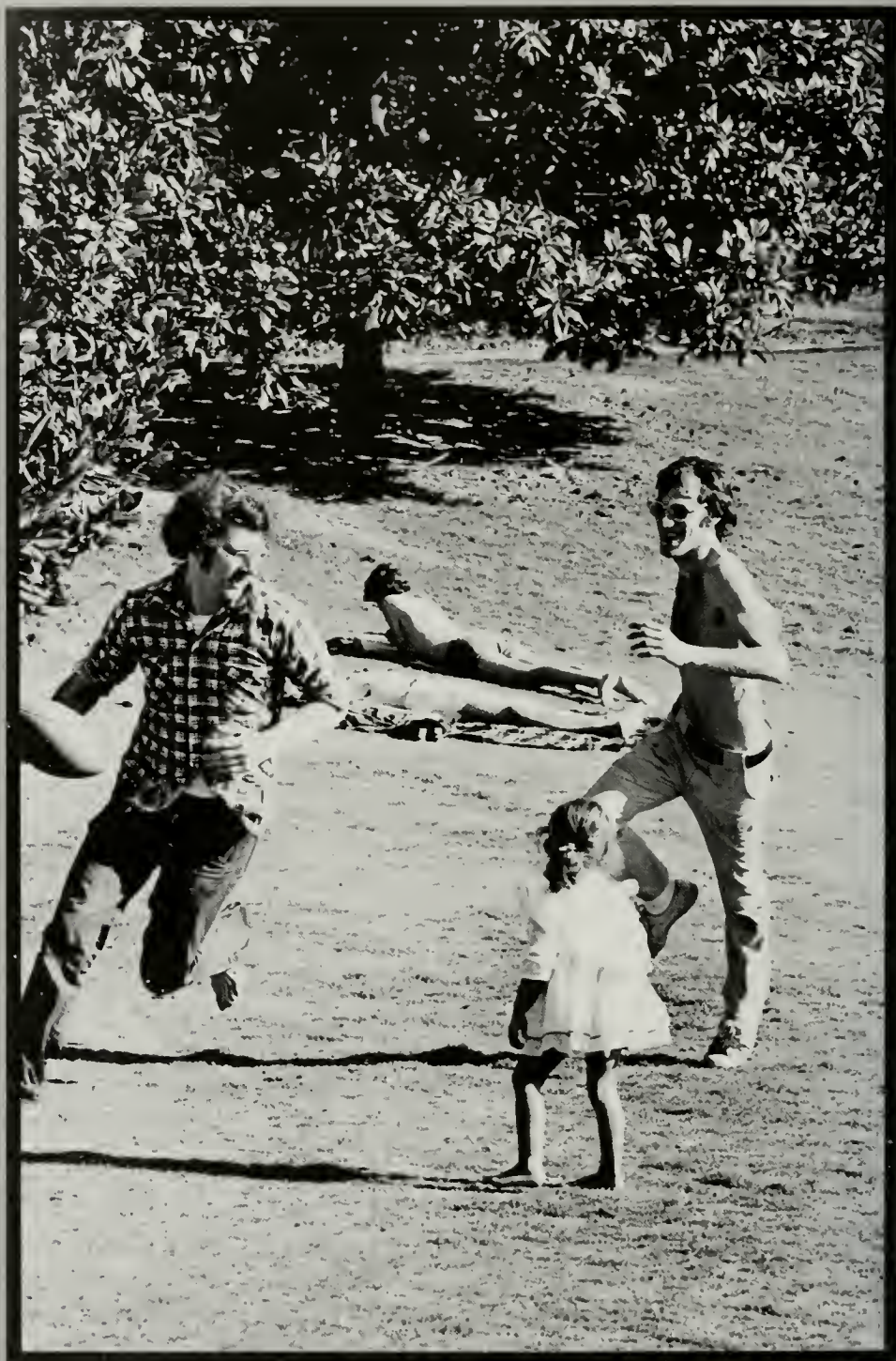
the conferences; when the parent is in a special appointment and resident in one of the conferences, eligibility will be determined on an individual basis depending upon the nature of the appointment. In all cases the decision of the University will be final.

**Employment.** Most financial aid recipients are offered a job as part of their aid package. These jobs require between nine and fifteen hours a week and provide an average stipend of \$700. The money is paid directly to the student. The Office of Placement Services maintains part-time employment listings for the campus and Durham area. All students interested in working during the school year should register at the beginning of the semester. Every effort will be made to help students find jobs consistent with their career interests.

Duke University also expects that students receiving financial aid will work during their summer vacation. In the summer before entering college, a freshman should save \$500 for use during his first year of college. In subsequent summers, the student should save \$700 to be used for college expenses.

**Paying the Bills.** Many families finance a college education with the assistance of an insured tuition payment plan regardless of whether they receive financial assistance from Duke. Although these plans are sponsored by a number of private firms, the University refers parents to plans provided by the Richard C. Knight Insurance Agency, Inc. The company provides the University with the full sum required each semester and arranges a schedule for monthly repayment by the subscribing families. The schedules for repayment vary with the program offered by the company. Additional information on this particular tuition payment plan may be obtained by writing to Richard C. Knight Insurance Agency, Inc., Insured Tuition Payment Plan, Sixth Street-James Avenue, Boston, Massachusetts 02116.





## Courses of Instruction





## Definition of Terms

Introductory-level courses are numbered below 100; advanced-level courses are numbered 100 and above. Courses numbered 1 through 49 are primarily for freshmen; courses numbered from 200-299 are primarily for seniors and graduate students. (See page 33 for regulations governing enrollment of other students in 200-level courses.)

Odd-numbered courses are usually offered in the fall semester; even-numbered courses in the spring semester. For courses which will be offered in 1976-77, consult the Official Schedule of Courses, available in the Registrar's Office. Double numbers separated by a hyphen indicate that the course is a year course and must normally be continued throughout the year if credit is to be received. Double numbers separated by a comma indicate that although the course is a year course, credit may be received for either semester without special permission. The following symbols, suffixed to course numbers, identify the small-group learning experiences: S, seminar; P, preceptorial; T, tutorial; D, discussion section.

## Air Force Aerospace Studies

For courses in Air Force Aerospace Studies, see the Reserve Officers Training Program.

## Anthropology

Professor Friedl, *Chairman*; Associate Professor Apte, *Director of Undergraduate Studies*; Professors Fox and LaBarre; Associate Professors Cartmill, Hylander, O'Barr, and Rosen; Assistant Professors Boon, Casson, Glander, Graedon (Nursing), Quinn, Smith, and Stack (Public Policy Sciences)

In special circumstances, students without necessary prerequisites listed for a course may request the consent of the instructor for admission.

**93. Human Origins.** Origins and distribution of mankind; primate evolution; a survey of human paleontology and human biology, prehistory, and language; and the origins of human social organization and culture. One course.  
*Staff*

**94. Elements of Cultural Anthropology.** The dynamics of culture and society; form and function of social institutions. Emphasis is upon primitive societies. Primarily meant for students not majoring in the social sciences. One course. *Staff*

**99. Cultural Anthropology.** Introductory study of culture, society, and human behavior with emphasis on theory and ethnography. Designed for social science majors and required for anthropology majors. One course. *Staff*

**101, 102. Introduction to the Civilization of Southern Asia.** (See Interdisciplinary Course 101, 102.)

**107. Introduction to Linguistics.** Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. Prerequisite: sophomore standing. (Also listed as English 107.) One course. *Apte, Butters, Casson, or Hull*

**115. Sex Roles in Evolutionary Perspective.** Bases for differentiation of tasks and power allocated to the sexes among hunters and gatherers, horticulturists, pastoralists, and plow agriculturists. Prerequisite: Anthropology 94 or 99. One course. *Friedl, Quinn, or Smith*

**116. Language, Ethnicity, and New Nations.** Examination of problems facing newly independent countries of Asia and Africa in developing national integration; from the theoretical perspectives of sociolinguistics and anthropology. Prerequisite: Anthropology 94 or 99. One course. *Apte*

**117. Language, Law, and Politics.** Theories of language in political and legal processes, bilingualism, strategic use of language, political rhetoric, discrimination through language. Primary ethnographic materials from the United States and Canada. Prerequisite: Anthropology 94 or 99. One course. *O'Barr*

**119. Language, Culture, and Society.** Analysis of language behavior within and across societies relating variations in linguistic usage to sociocultural factors: ethnosemantics, social dialects, and ethnography of speech. Prerequisite: Anthropology 107. One course. *Apte, Casson, or Rosen*

**123. Peoples of the World: Mediterranean Europe.** Emphasis on economic developments and change in rural communities and on the urbanization of migrants. Prerequisite: Anthropology 94 or 99. One course. *Friedl*

**124. Peoples of the World: American Indian.** A comprehensive survey of the Indians of North and South America, including a study of origins and prehistory, archeology, racial affiliations, languages, material culture, social and political organization, economics, and religion, discussed in terms of the "culture area." One course. *LaBarre*

**125. Peoples of the World: Africa.** A survey of the indigenous cultures and societies of Africa and the study of kinship, politics, economics, religion, and sociocultural change. Prerequisite: Anthropology 94 or 99. One course. *O'Barr*

**126. Peoples of the World: Oceania.** Selected problems in the development of pre-European and post-European cultures. The relationship between man and Pacific environments. Prerequisite: Anthropology 94 or 99. One course. *Staff*

**127. Peoples of Mesoamerica.** Development and organization of diverse societies and institutions in Mexico and Guatemala. Prerequisite: Anthropology 94 or 99. One course. *Smith*

**129. Peoples of the World: Middle East.** Emphasis on language, kinship,

economics, politics, and religion. Prerequisite: Anthropology 94 or 99. One course. *Casson or Rosen*

**130. Social and Cultural Change.** Contemporary theories of change, including innovation, acculturation, and modernization. Prerequisite: Anthropology 94 or 99. One course. *O'Barr or Smith*

**131D. Principles of Archeological Investigation.** (Also listed as Religion 131D.) One course. *Meyers*

**132. Human Evolution.** Evolutionary biology of the primates. Anatomical and behavioral adaptations and phylogeny of fossils and living primates including *Homo sapiens*. Prerequisite: Anthropology 93 or equivalent. (Also listed as Anatomy 231.) One course. *Cartmill or Glander*

**133. The Effects of Colonialism and Neo-Colonialism on Native Peoples.** The effect of governmental policies and interests, dominant populations, and local and international economic concerns on indigenous peoples, whether living as enclaves in nation states or as dependencies. One course. *Quinn and Smith*

**134. Political Anthropology.** Comparative study of politics and government in tribal and peasant societies. Evolution of political systems. Political changes resulting from contact and colonialism. Prerequisite: Anthropology 94 or 99. One course. *O'Barr or Smith*

**135. Anthropological Research in American Culture.** Substructures in American society studied by ethnographic field methods. Prerequisite: Anthropology 94 or 99. One course. *Quinn*

**137. Kinship and Social Organization.** Anthropological study of kinship relations and social groups: family, marriage, residence, terminology, descent, and alliance. Prerequisite: Anthropology 94 or 99. One course. *Casson*

**140. Myth and Ritual, Literature and Drama.** Symbolic action and expressive culture among tribal, caste, class, and industrial societies. Intensive case study using the various approaches, including diffusionism, archetypes, functionalism, French structuralism, and cultural interpretation. One course. *Boon*

**141. Peoples of the World: Southeast Asia.** Major social, cultural, and religious systems—Hindu-Buddhism and Islam—and examples of populations relatively isolated from the historical expansion of these systems. Emphasis placed on island Southeast Asia. Prerequisite: Anthropology 94 or 99. One course. *Boon*

**142. Peoples of the World: South Asia.** Survey of indigenous cultures and societies of India, Pakistan, Sri Lanka, Bangladesh, Nepal, and Bhutan with emphasis on social institutions, behavioral patterns, value systems, and socio-cultural change. Prerequisite: Anthropology 94 or 99. One course. *Apte or Fox*

**146. Cross-Cultural Perspectives on Health Care Delivery.** (Also listed as Nursing 146.) *Dietz and Graedon*

**150. Law and Anthropology.** Adjudication and dispute settlement in primitive and small-scale societies. Western legal developments compared with those of new nations. American legal problems from the anthropological perspective. Prerequisite: Anthropology 94 or 99. One course. *Rosen*

**162. Cultural Ecology.** Human interaction with the environment and the effect of ecology on social structure. Prerequisite: Anthropology 94 or 99. One course. *Smith*

**164. Peasantry and Peasant Movements.** The genesis of peasant movements.

Forms of peasant protest and its role in the economic, political, and ritual life of societies. Case studies from Western and Eastern societies, past and present. Prerequisite: Anthropology 94 or 99. One course. *Fox or Smith*

**165. Psychological Anthropology.** The mutual relevance of anthropology to child development, social learning, small-group interaction, cognition. Prerequisite: Anthropology 94 or 99. One course. *Quinn*

**166. Introduction to Archeology: Man and Culture.** Modern methodology and analysis; theories of cultural evolution; survey of world prehistory with an exploration of the uses of ethnographic analogy. Prerequisite: Anthropology 94 or 99. One course. *Staff*

**170. Economic Anthropology.** Traditional economic systems, including land tenure, division of labor, exchange, leveling mechanisms and markets; the response of traditional economies to forces such as population pressure, migratory labor, plantation agriculture, and agricultural innovation. Prerequisite: Anthropology 94 or 99. One course. *Quinn or Smith*

**185T, 186T. Junior Tutorial.** Prerequisites: Anthropology 94 or 99 and consent of the Director of Undergraduate Studies. Half course or one course. *Staff*

**193. Independent Study.** Directed reading and research. Open only to qualified students in the senior year, by consent of the Director of Undergraduate Studies. One course. *Staff*

**195S, 196S. Senior Seminar.** Prerequisites: Anthropology 94 or 99 and any two 100-level courses in anthropology and consent of the Director of Undergraduate Studies. Half course or one course. *Staff*

## For Seniors and Graduates

**210. Linguistic Anthropology: Theory.** Examination and comparison of predominant schools of language study—comparative-historical, structural, transformational, stratificational, and generative semantics. Prerequisite: Anthropology 107 or consent of instructor. One course. (3 graduate units.) *Apte or Casson*

**211. Linguistic Anthropology: Ethnography of Communication.** Verbal and nonverbal communication from linguistic and anthropological perspectives with emphasis on synchronic and diachronic aspects of communication, development of sociolinguistic theory and its application to intra- and intercultural communicative processes. Prerequisite: Anthropology 107 or consent of instructor. One course. (3 graduate units.) *Apte or Casson*

**220S. Society and Culture in India.** The basic features of Indian cultures and societies from an anthropological perspective. The impact of selected technological and social changes upon the individual, caste, and community. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course (3 graduate units.) *Apte or Fox*

**222. Topics in African Anthropology.** Research problems illustrated through ethnographic studies of African societies. One course. (3 graduate units.) *O'Barr*

**242. Topics in Prehistory.** Anthropological issues derived from archeological and early historical investigations. Prerequisite: Anthropology 93 and 94 or equivalent. One course. (3 graduate units.) *Staff*



**243. Theory and Method in Archeology.** Techniques of geochronology, environmental reconstruction, sociocultural reconstruction, and statistical analyses applied to problem areas in archeology—human cultural origins, Paleolithic and post-Pleistocene readaptations, origins of agriculture and civilization. Prerequisite: Anthropology 166 or consent of instructor. One course. (3 graduate units.) *Staff*

**244. Primate Behavior.** Examination of the social behavior of prosimians, monkeys, and apes in an attempt to understand the evolutionary development of the primate order and the origin of man. One course. (3 graduate units.) *Glander*

**245. Functional and Evolutionary Morphology of Primates.** History and functional significance of locomotor and feeding adaptations, craniofacial morphology, sense organs, and reproductive systems in primates, including *Homo sapiens*. Prerequisite: Anthropology 132 (Anatomy 231) or equivalent, or consent of instructor. (Also listed as Anatomy 238.) One course. (3 graduate units.) *Cartmill or Hylander*

**246. The Primate Fossil Record.** Evolution of man and other primates as inferred from fossil remains. Prerequisite: a course in human evolution or consent of instructor. One course. (3 graduate units.) *Cartmill or Kay*

**249. Topics in Economic Anthropology.** Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *O'Barr, Quinn, or Smith*

**250. The Anthropology of Cities.** Organization and behavior of men in urban centers analyzed from an evolutionary perspective; cross-cultural analysis of cities and their varying roles. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *Fox*

**251. Ethnography of Humor.** Examination of theoretical framework, research methods and data-collection techniques for the analysis of humor with the goal of discerning normative behavioral patterns, expectations regarding social roles, interpersonal relationships and social institutions, and the nature of ideologies and world views, within and across cultures. Prerequisite: Anthropology 94 or 99 or consent of instructor. One course. (3 graduate units.) *Apte*

**259. Linguistic Anthropology: Language Acquisition.** Biological basis of human linguistic capacity; major theoretical positions in linguistics; acquisition of semantics, syntax, and phonology in English and other languages. Prerequisite: Anthropology 107 or consent of instructor. One course (3 graduate units.) *Casson*

**264. Primitive Religion.** The ethnology, social functions, and the socio-psychological meanings of religion in primitive societies. One course. (3 graduate units.) *LaBarre*

**265. Personality and Society.** The sociology and social psychology of human personality, its origins in the primary group, its nature and varieties, and its integrations into secondary group institutions. One course. (3 graduate units.) *LaBarre*

**266. Personality and Culture.** The influence of culture patterns and social institutions upon character structure, socialization of the individual, and the dynamics of human personality. Comprehensive anthropological materials will be drawn upon. One course. (3 graduate units.) *LaBarre*

**267. Cognitive Anthropology.** Theoretical and methodological developments in the study of taxonomies, naturally occurring categories, information-

processing rules, decisions, and belief systems. Psychological testing of non-Western people; effects of schooling. Prerequisite: Anthropology 94 or 99. One course. (3 graduate units.) *Quinn*

**268. Law and the American Indian.** Survey of the legal status and problems of the contemporary American Indian. Topics include the basis and extent of tribal sovereignty, the relation of states and their Indian citizens, treaties and Indian claims actions, the legal context of economic development, and the legal position of Eastern American Indians. One course. (3 graduate units.) *Rosen*

**270. Ethnographic Field Methods.** Research strategies and techniques for field research; participation in a field project in a local community. One course. (3 graduate units.) *Casson, O'Barr, or Quinn*

**271. Methods of Data Analysis.** Quantitative analysis of anthropological data. One course. (3 graduate units.) *Quinn*

**272. Primitive Music.** A comparative ethnological study of non-Western music, emphasizing different scales (mode, raga, maḡam, lu ) conventions, styles, social functions, and cultural contexts; some attention to the African origins of jazz. Sufficient technical background will be provided for the non-specialists. One course. (3 graduate units.) *LaBarre*

**273. Primitive Art.** A comparative ethnological study of non-European art and artists emphasizing media, conventions, social functions, and cultural contexts. One course. (3 graduate units.) *LaBarre*

**275. Rank, Power, and Authority in Pre-Industrial Societies.** The role and development of social, economic, and political stratification in specific societies in Oceania, Africa, and the New World. Prerequisite: concentration in anthropology or graduate standing. One course. (3 graduate units.) *Fox*

**276. Analysis of Kinship Systems.** Primitive relationship categories as related to legal norms and social groupings. Theoretical issues and contrasting approaches to the analysis of social classification terminologies. One course. (3 graduate units.) *Boon or Casson*

**277. Class, Ethnicity and Public Policy.** (Also listed as Public Policy Sciences 277.) One course. (3 graduate units.) *Stack*

**278S. Special Topics in Political Anthropology.** Current research problems. Topics will change each semester. Prerequisite: Anthropology 134 or consent of instructor. One course. (3 graduate units.) *O'Barr or Quinn*

**280S, 281S. Seminar in Selected Topics.** Special topics in methodology, theory, or area. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Staff*

**291, 292. Anthropological Theory.** Theoretical, methodological, and comparative issues. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Boon, Fox, or Quinn*

## DEPARTMENTAL MAJOR

*Major Requirements.* Eight courses in the department, two of which must be 93 and 99 and at least two of which must be senior-graduate courses.

An anthropology major normally takes at least four related courses in departments recommended by his anthropology advisor. Such courses are usually in the Departments of Anatomy, Art, Botany, Economics, History, Mathematics, Political Science, Psychology, Sociology, and Zoology.

*Honors.* Qualified majors are encouraged to participate in special work leading to graduation with distinction in anthropology. (See the section on Honors in this *Bulletin* for general requirements.) Any major with a B+ average in anthropology courses and with a B average in all courses is eligible. Students who desire to undertake honors work should request a member of the anthropology faculty to recommend their names to the Director of Undergraduate Studies. To receive departmental honors a major must complete a paper involving a significant independent research or scholarship and pass an oral examination on the paper conducted by an appointed committee of faculty members at least two of whom should be in anthropology. Normally, students will prepare the paper over the course of the senior year working in close collaboration with their committee and receiving on the average two course credits in independent study for the work.

## Art

Professor Markman, *Acting Chairman*; Assistant Professor Brown, *Director of Undergraduate Studies, Art History*; Assistant Professor Pratt, *Director of Undergraduate Studies, Design*; Professors Jenkins, Mueller, Sunderland; Associate Professor Stars; Assistant Professors Connolly, Lichtenstein; Instructor Smullin; Part-time Lecturer van Dijk; Part-time Instructors Menapace, S. Pratt, and White

### HISTORY OF ART

Introductory courses in art history (Art 61 through 66) are designed as studies in the development of architecture, sculpture, painting, and minor arts as material manifestations of Western culture from ancient to modern times, with some reference to primitive, Oriental, and other non-Western cultures. A student receives instruction in the history of art and in methods of art historical analysis. Credit may not be allowed for more than two courses in the sequence. Introductory courses are open to freshmen, as well as upperclassmen.

**61. Introduction to the History of Architecture and Sculpture.** One course.  
*Staff*

**62. Introduction to the History of Painting and Sculpture.** One course.  
*Staff*

**63. Introduction to Ancient Art.** Architecture, sculpture, and painting from ancient Egypt through the Roman period. One course. *Markman*

**64. Introduction to Medieval Art.** Development of architecture, sculpture, painting, and related arts; mostly Christian; from about 300 A.D. to about 1400. Prerequisite: Art 61, 62, or 63. One course. *Sunderland*

**65. Introducing to Renaissance and Baroque Art.** Development of architecture, sculpture, and painting in Western Europe from about 1400 to about 1750. Prerequisite: Art 61, 62, or 63. One course. *Jenkins*

**66. Introduction to Modern Art.** Development of architecture, sculpture, and painting in Europe and America from about 1750 to the present. Prerequisite: Art 61, 62, or 63. One course. *Brown or Connolly*

**131. Art and Archeology of the Hellenic World.** Preliminary treatment of archeological material from the Aegean, the geometric, and orientalizing periods, followed by the architecture, sculpture, and vase paintings of ancient Greece from archaic through Hellenistic times. Not open for credit to students who have taken Classical Studies 55. One course. *Markman*



**132. Roman Art and Archeology.** The archeological background for the formation of the Roman style as derived from Etruscan, Greek, and indigenous Italian sources; followed by the architecture, sculpture, and painting from the early Republic to the end of the Empire in Italy and in the provinces. Not open for credit to students who have taken Classical Studies 56. One course. *Markman*

**133. Medieval Architecture.** A survey of Christian architecture in the Near East, the Balkans, Russia, and Western Europe from the beginnings of the medieval style in the late classical period to its disintegration in the fifteenth century. One course. *Sunderland*

**134. Medieval Painting and Sculpture.** A study of painting, including mosaics, manuscripts, stained glass, and sculpture in Western Europe from the late classical period through the fourteenth century. One course. *Sunderland*

**135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries.** First semester: Netherlandish, French, and Spanish painting with some reference to Franco-Flemish illumination. Second semester: German, Austrian, and Bohemian painting, graphic arts, and sculpture. Two courses. *Mueller*

**137, 138. Italian Renaissance Art.** A consideration of Italian sculpture and painting in the fourteenth, fifteenth, and sixteenth centuries. First semester: the art of the fourteenth and fifteenth centuries. Second semester: the sixteenth century. Prerequisite: Art 61 or 62 or the consent of the instructor. Two courses. *Jenkins*

**140. Seventeenth Century Painting and Sculpture in Europe.** Evolution of the Baroque style in European painting and sculpture, with some attention being given to related manifestations in the late sixteenth and early eighteenth centuries. Particular emphasis is laid on developments in Flanders, France, Holland, and Spain. Prerequisite: Art 61 or 62 or 65 or consent of the instructor. One course. *Jenkins*

**141, 142. American Art.** A survey of architecture, sculpture, and painting from the time of the first settlers to the present, including the contributions of the English, Dutch, French, and Spanish to the artistic heritage of the United States. Two courses. *Brown or Connolly*

**143S. History of Prints and Drawings.** Fifteenth century to the present. Prerequisite: Art 62, 65, or 66 or consent of the instructor. One course. *Mueller*

**144. Renaissance and Baroque Architecture.** A study of the development of Renaissance architecture in Italy from its beginnings in the fifteenth century in the works of Brunelleschi to its flowering in the seventeenth century Baroque works of Bernini and Borromini; along with a consideration of the spread of Italian Renaissance forms to northern Europe in the sixteenth century and its development into a Baroque style in the seventeenth century. One course. *Sunderland*

**146. Recent Interpretation of Contemporary Art.** Appraisal of critical art historical issues through the study and discussion of the visual arts and their criticism since World War II. Prerequisite: Art 66 or consent of instructor. One course. *Connolly*

**147. Painting and Sculpture in the Eighteenth and Nineteenth Centuries.** An investigation of the development of painting from the final stages of the Baroque in the eighteenth century to the period of the Impressionist Movement in the last decades of the nineteenth century. One course. *Sunderland*

**148. Modern Painting and Sculpture: 1863 to 1905.** The rise of the antiaca-



demic movements of Impressionism, Divisionism, Symbolism, and the Art Nouveau, emphasizing Manet, Van Gogh, Gauguin, Seurat, and Cezanne. Prerequisite: Art 62 or 66. One course. *Brown, Connolly, or Lichtenstein*

**149. Pre-Columbian Art and Archeology.** Architecture, sculpture, pottery, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region of South America before the Spanish conquest. One course. *Markman*

**150. Latin American Art.** Architecture, painting, sculpture, and other arts. Emphasis on the architecture of the colonial period. One course. *Markman*

**165. Painting and Sculpture: 1905 to the Present.** Evolution and interaction of major European and American movements. Prerequisite: Art 148 or consent of the instructor. One course. *Brown*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified students in the junior year, by consent of the department. Two courses.

**193, 194 Independent Study.** Directed reading and research. Open only to qualified students in the senior year, by consent of the department. Two courses.

### For Seniors and Graduates

**233. Early Medieval Architecture.** The development of religious architecture from the time of Constantine to the end of the first Romanesque style in the third quarter of the eleventh century. One course. (3 graduate units.) *Sunderland*

**237. French Renaissance Art.** Sixteenth century painting and sculpture in France with special emphasis on Italian influences. Prerequisites: some knowledge of Italian Renaissance art and the ability to read French, or consent of the instructor. One course. (3 graduate units.) *Jenkins*

**244. Neoclassicism.** Origin and evolution of Neoclassicism in the visual arts emphasizing comparison to contemporary stylistic alternatives and international aspects of the style. Prerequisite: Art 66 or consent of instructor. One course. (3 graduate units.) *Connolly*

**247. Problems in the History of Graphic Arts.** Selected topics in the history of prints and drawings. One course. (3 graduate units.) *Mueller*

**249. Problems in Pre-Columbian Art and Archeology.** Architecture, sculpture, and other arts of the indigenous civilizations in Mexico, Central America, and the Andean region. Prerequisite: Art 149, apposite courses in Anthropology or Latin American history or consent of instructor. One course. (3 graduate units.) *Markman*

**250. Problems in Latin American Art.** Architecture, painting, sculpture and other arts with emphasis on colonial architecture of Central America. Open to seniors who have a reading knowledge of Spanish and/or have had courses in Latin American history, economics, or literature. One course. (3 graduate units.) *Markman*

**254. Problems in Modern Architecture.** A particular movement, master or idea studied as a problem in criticism and methodology; influence on design and building. Prerequisite: Art 61 or consent of instructor. One course. (3 graduate units.) *Brown*

**257, 258. Problems in Modern Art.** Selected topics in nineteenth and twentieth century European art, with emphasis on one or more major movements or

masters. Prerequisite: Art 66 or 148 or consent of the instructor. Two courses. (6 graduate units.) *Lichtenstein*

**259. Romanticism.** Emphasis on the French school of painting; sources in English, German, and Spanish art. Prerequisite: knowledge of nineteenth century art and ability to read French; or consent of instructor. One course. (3 graduate units.) *Lichtenstein*

**293, 294. Special Problems in Art History.** Individual study and research. Two courses. (6 graduate units.) *Staff*

## DESIGN

**53. Drawing.** Directed approaches to practice in life drawing and in the expression of graphic concepts. Prerequisite: consent of the instructor. One course. *S. Pratt and Smullin*

**54. Two-Dimensional Design.** Experiments in form and color, with work from observation. Introduction to color theory in painting and two-dimensional media. Prerequisite: Art 53 or consent of the instructor. One course. *S. Pratt*

**56. Three-Dimensional Design.** An introduction to studio exploration of sculpture. Visual experience in an exploration of form; from point, line, and plane to space, mass, and time. Perceptual, structural, analytical, synthetic, and fantastic approaches. Prerequisite: Art 53 or consent of instructor. One course. *Smullin*

**151, 152. Photography.** Emphasis on interaction of technique, perception, and communication in making and responding to photographic images. Some work with view cameras furnished by the department; students must provide own hand camera. Prerequisite: submission of portfolio, Art 53, or consent of the instructor. Two courses. *Menapace*

**153, 154. Painting.** Studio practice in painting with individual and group criticism and discussion of important historic or contemporary ideas. Prerequisite: Art 54 (or equivalent) or consent of instructor. Two courses. *V. Pratt*

**155, 156. Advanced Drawing and Color.** Work from life or in formal modes, with emphasis on personal development, through individual and group criticism and discussion. Prerequisite: Art 53 and 54 and consent of instructor. Two courses. *V. Pratt*

**159, 160. Printmaking.** Wood engraving, block printing, copperplate engraving, etching, aquatint, and drypoint. Prerequisites: Art 53, 54 or consent of instructor. Two courses. *White*

**161, 162. Sculpture.** Realistic modeling in clay from human model. Work in abstract modes. Introduction to casting, carving, and welding. Second semester: independent problems. Prerequisite: Art 56 or consent of instructor. Two courses. *Smullin*

**164. Ceramics.** Design, production, and conceptualization of three-dimensional forms. One lecture and four studio hours each week. One course. *Stars*

**171, 172. Advanced Sculpture.** Prerequisite: Art 161 and 162. Two courses. *Smullin*

**173, 174. Advanced Painting.** Prerequisites: Art 153 and 154 and consent of instructor. Two courses. *V. Pratt*

**181 182. Individual Project.** Independent work open to highly qualified seniors on recommendation of the instructor and invitation of the department. Two courses. *Staff*

## ELECTIVE FOR ART MAJORS

**119. Fine Arts Photography Laboratory.** History and development of photography as documentation and art; use of materials, techniques, laboratory, and studio practice. Open only to art majors. A fee of \$25 will be charged, payable upon notification from the Bursar's office at the beginning of the semester. Half course. *van Dijk*

## DEPARTMENTAL MAJOR

The student will elect a sequence of courses emphasizing either the history of art or design. The department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

### Major in History of Art

*Prerequisites.* Two courses from the sequence 61-66 of which at least one must be 61 or 62.

*Major Requirements.* Eight courses above the 60 level of which two must be at the 200 level. Majors must complete two years of college level study, or equivalent, of a foreign language. Students contemplating graduate study in art history are advised to acquire a reading knowledge of at least two foreign languages, one of which should be German.

### Major in Design

*Prerequisites.* Introduction to art history, two courses from the sequence 61-66. Art 53, 54.

*Major Requirements.* Five studio courses exclusive of Art 53, 54.

*Studio Fees.* To cover materials supplied in design courses, a fee of \$40 per semester for all courses will be charged payable upon notification from the Bursar's office at the beginning of each semester.

## Asian and African Languages

### CHINESE

**131, 132. Elementary Chinese.** Four hours of classwork and two hours of language laboratory drill. Two courses. *Kunst*

**133, 134. Intermediate Chinese.** Four hours of class work and two hours of language laboratory drill. Two courses. *Kunst*

**135, 136. Introduction to Modern Chinese Literature.** Prerequisites: Chinese 133, 134 or equivalent. Two courses. *Kunst*

**141. Chinese Literature in Translation.** Masterpieces of traditional Chinese poetry, fiction, and drama. One course. *Kunst*

### HINDI-URDU

**171, 172. Studies in Indian Literatures.** Readings in translation. First semester: classical Indian literary traditions. Second semester: literatures from Indian languages, including novels, poetry, and drama, with special reference to European literary influences. (Also listed as Comparative Literature 171, 172.) Two courses. *Shonek*

**173, 174. Literature and Revolution.** Post World War I literatures of Asia and Africa in the context of contemporary socio-political revolutions. Readings in English. Two courses. *Shonek*

**181, 182. Intensive Elementary Hindi-Urdu.** Four hours of classroom work; two hours of language drill. Concentration on the acquisition of conversational ability in Hindi-Urdu, with a grammar and vocabulary basic to both Hindi and Urdu. Introduction to the Devanagari script and the reading of graded texts. Two courses. *Shonek*

**183, 184. Intensive Intermediate Hindi-Urdu.** Four hours of classroom work, two hours of language drill. Advanced conversation in Hindi-Urdu reading and composition. Prerequisite: elementary Hindi-Urdu. Two courses. *Shonek*

**185, 186. Advanced Hindi Reading and Composition.** An introduction to scholarly and literary Hindi prose and extensive practice in composition. Prerequisite: Hindi-Urdu 183, 184, or equivalent. Two courses. *Shonek*

## JAPANESE

**151, 152. Elementary Japanese.** Four hours of class work and two hours of language laboratory drill. Two courses. *Kunst*

**153, 154. Intermediate Japanese.** Four hours of class work and two hours of language laboratory drill. Two courses. *Kunst*

**153, 154. Intensive Intermediate Japanese.** Four hours of class work and two hours of language laboratory drill. Two courses. *Kunst*

**155, 156. Introduction to Modern Japanese Literature.** Prerequisite. Japanese 153, 154, or equivalent. Two courses. *Rolf*

**161. Modern Japanese Fiction in Translation.** Readings of twentieth century Japanese novels and short stories. One course. *Rolf*

## SWAHILI

**101, 102. Elementary Swahili.** Three hours of classroom work, plus language drill. Two courses. *Houpe*

## Astronomy

For courses in Astronomy, see *Physics*.

## Biology

**11-12. Principles of Biology.** A two-semester introduction to the discipline open only to freshmen and sophomores who have had no more than one year of biological science in high school. (Entering freshmen will be given priority.) Lectures and laboratories. Two courses. *Staff*

**11P, 12P. Preceptorials.** Elective preceptorials for students enrolled in Biology 11, 12. *Staff*

**14. Principles of Biology.** A one-semester introduction to the discipline open to freshmen with at least one year of biological science in high school and to all upperclassmen. Lectures and laboratories. (Offered in fall and spring terms.) One course. *Staff*

**14P. Preceptorial.** Elective preceptorial for students enrolled in Biology 14.

The above offerings, 11-12 and 14, may not both be taken for credit; either is an acceptable prerequisite for advanced courses. See other courses listed under *Botany* and *Zoology*.



## Interdepartmental Concentration

An interdepartmental program (e.g., in cell and molecular biology, physical biology, and marine biology) may be pursued instead of a departmental major. The appropriate director of undergraduate studies in botany or zoology will arrange administrative responsibility for such programs.

## Black Studies

Mr. Turner, *Acting Director*; Assistant Professors Burford and Gavins

Black Studies is designed to provide instruction and study directed toward the experience of Black America and its concerns. Though a major is worthwhile and encouraged, many of the course offerings complement other majors and serve also as essential components of a liberal arts education.

Courses in Black Studies may count toward the distributional requirements. The distributional division for each course follows the description.

**99. Dimensions of Racism.** The nature of racism, its interconnection with aspects and institutions of American life and its effects. (Social Sciences) One course. *Staff*

**100. Philosophy of Black Liberation.** (Humanities) One course. *Staff*

**113. African Philosophy.** Religious and political philosophy of twentieth-century Africa. (Also listed as Religion 113; Humanities) One course. *Staff*

**125. Religion and Theology of Black America.** (Also listed as Religion 125; Humanities) One course. *Burford*

**145, 146. Afro-American History.** The Black experience in America from slavery to the present. (Also listed as History 145, 146; Social Sciences.) Two courses. *Gavins*

**147. The Black in the City.** (Also listed as Sociology 147; Social Sciences.) One course. *Preiss*

**150. Third World Literature.** Selected works with special emphasis upon Black American, African, and Caribbean writers. (Humanities.) One course. *Staff*

**151. Classic Literature of Black America.** Works by Black authors of the Negro renaissance followed by Wright's *Native Son* and Ellison's *Invisible Man* (Humanities.) One course. *Staff*

**152. Contemporary Literature of Black America.** Essays, poetry, and fiction by contemporary Black writers. (Humanities.) One course. *Staff*

**176, 177. Marxism and Black Liberation.** Marxist perspective on the liberation of Black America. (Social Sciences.) Two courses. *Staff*

**185S. Black Studies.** African influence on Western civilization. (Humanities.) One course. *Staff*

**189S. Special Topics.** (Humanities or Social Sciences.) One course. *Staff*

**191, 192. Independent Study.** (Humanities or Social Sciences.) Two courses. *Staff*

**193, 194. Independent Study in Community or Field Work.** (Humanities or Social Sciences.) Two courses. *Staff*

**195, 196. Problems in Afro-American History.** (Also listed as History 195V, 196V; Social Sciences.) Two courses. *Gavins*

## THE MAJOR

Black Studies 99 and 100 are required for the major and strongly recommended as introductory courses work in Black Studies. Black History 145, 146, 193, and 194 are required. (It is suggested that the student seek his own community assignment and request approval.) Three other courses above 100 are to be selected. One must be a seminar; and one may be 193 or 194, but not both.

Students majoring in Black Studies will receive special counseling planning their course of study and in considering their future vocation.

## Botany

Professor Wilbur, *Chairman*; Professor White, *Director of Undergraduate Studies*; Professors Anderson, Billings, W. Culberson, Hellmers, Johnson, Naylor, Philpott, and Stone; Associate Professors Antonovics, Barber, Boynton, Knoerr, Searles, and Strain; Assistant Professors Blankley and Christensen; Lecturer C. Culberson

See *Biology* for a listing of introductory courses.

The L suffix on a course number indicates that the course includes a laboratory. Note that in some courses the laboratory is optional, and a student may register for these courses with (e.g., Botany 135L) or without (e.g., Botany 135) the laboratory.

**51L. Culture and Propagation of Plants.** Principles of physiology, genetics, ecology, and taxonomy as applied to horticulture. Lectures, greenhouse and garden work, and field trips. Prerequisite: introductory college biology. One course. *Philpott*

**53. Introductory Oceanography.** Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one course in a laboratory science. (Also listed as Geology 53.) One course. *Pilkey (Geology) and Searles*

**63. Ecology and Man.** Principles of populations, communities, and ecosystems with applications to human society. One course. *Christensen or Strain*

**75. Plants of the Southeast.** Survey of the flora stressing biological and geological factors related to present day floristic and evolutionary patterns. One course. *Stone*

**90. Plants and Man.** The co-evolution of agriculture and civilization; man's invention of elite races of domesticated plants from wild species by artificial selection. The economic botany of the world's major crops. One course. *Culberson or Wilbur*

**103L. General Bacteriology.** A study of the morphology and fundamental physiological processes of bacteria: their relationship to sanitation, public health, soil fertility, and food preservation. Prerequisite: introductory biology. One course. *Johnson*

**135. Evolutionary Systematics.** Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186 and Zoology 286. Lectures. Prerequisite: college biology. (Also listed as Zoology 135 and Zoology 235.) One course. *Bailey (Zoology), Lundberg (Zoology), and Stone*

**135L. Evolutionary Systematics.** See Botany 135. Lectures and laboratories. One course. *Bailey (Zoology), Lundberg (Zoology), and Stone*

**142L. Systematics.** Principles of vascular plant taxonomy with practice in collection and identification of the local flora. Lectures, laboratories, and field trips. One course. *Wilbur*

**145L. Plant Diversity.** Major groups of the living plants, their evolutionary origins and phylogenetic relationships. Prerequisite: introductory biology. One course. *Culberson and White*

**146L. Plant Ecology.** Principles of the relationships between plants and their environments. Structures and processes of ecosystems. Laboratory, lectures, and field trips. Prerequisites: introductory biology and one other course in biology. One course. *Billings, Christensen, or Strain*

**151L. Plant Physiology.** The principal physiological processes of plants, including water relations, mineral nutrition, synthesis and use of foods, and growth phenomena. Prerequisites: Introductory college biology and one year of chemistry; organic chemistry is desirable. One course. *Naylor*

**160L. Plant Anatomy.** A comparative study of basic cell types, tissues, and organs of vascular plants. Correlation of anatomical information with pertinent literature, application of anatomy to problems in systematics and evolution, and the interrelationship between structure and function. Prerequisite: one year of biology or consent of instructor. One course. *White*

**169L. The Marine Environment.** (For description see Marine Sciences.)

**180. Principles of Genetics.** Structure and properties of genes and chromosomes, and evolution of genetic systems. Lectures. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31 or their equivalents. (Also listed as Botany 280, Zoology 180, Zoology 280, and under the University Program in Genetics.) One course. *Antonovics, Boynton, and Gillham (Zoology)*

**180L. Principles of Genetics.** See Botany 180. Lectures and laboratories. One course. *Antonovics, Boynton, Gillam (Zoology), and Ward (Zoology)*

**186. Evolutionary Mechanisms.** Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135 and Zoology 235. Prerequisite: college biology. (Also listed as Zoology 186, Botany 286, Zoology 286, and under the University Program in Genetics.) *Antonovics and H. Wilbur (Zoology)*

**191, 192. Independent Study.** Directed reading and research. Open to qualified students in the junior and senior years by consent of department. Credit to be arranged. *Staff*

**193T, 194T. Tutorial in Botany.** Credit to be arranged. *Staff*

**195S, 196S. Seminar in Botany.** Credit to be arranged. *Staff*

**202L. Phytoplankton Systematics.** Taxonomy and classification of marine phytoplankton; general characteristics, phytogeography, life histories, and study techniques. Individual projects. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Blankley*

**203. Cytogenetics.** Organization and variation of chromosomes in relation to genetics and evolution. Meiotic behavior and variation, chromosomal rearrangements, polyploidy, karyotype evolution, and mechanisms of chromosomal changes. Prerequisite: one year of biology. One course. (3 graduate units.) *Anderson*

**203L. Cytogenetics.** See Botany 203. Lectures and laboratories. One course. (4 graduate units.) *Anderson*

**204L. Marine Microbiology.** The major groups of marine microorganisms, their taxonomy, culture, physiology, and ecology. Prerequisite: a course in introductory biology or botany. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Blankley*

**206L. Anatomy of Woody Plants.** Primary and secondary structures in seedlings and in mature trees, shrubs, and vines. Preparation techniques for gross observations, and for study of micro and ultrastructures with light and electron microscopy. Relationship of microstructures to growth habits and physical properties of woody plant parts. Comparative studies in relation to ecological and systematic topics. (Also listed as Forestry 206.) Prerequisite: college botany or biology. One course. (4 graduate units.) *Philpott*

**207L. Microclimatology.** (Also listed as Forestry 207.) One course. (3 graduate units.) *Knoerr*

**209L. Lichenology.** Morphology, systematics, and biological and ecological implications of the lichens. Collection and identification of specimens and the use of lichen chemistry in taxonomy. One course. (3 graduate units.) *W. Culbertson* or *C. Culbertson*

**210L. Bryology.** Morphological, systematic, and ecological characteristics of mosses and liverworts. One course. (3 graduate units.) *Anderson*

**211L. Marine Phycology.** An introduction to marine algae; their identification, taxonomy, morphology, physiology, and ecology. Field trips complemented by laboratory study, culturing, and preparation of herbarium material. Given at Beaufort. One and one half courses. (6 graduate units.) *Searles*

**212L. Phycology.** Morphological and ecological characteristics of common freshwater and marine algae and principles of their classification. One course. (4 graduate units.) *Searles*

**214L. Biological Oceanography.** See Zoology 214. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barber*

**217L. Environmental Instrumentation.** (Also listed as Forestry 217.) Prerequisite: consent of instructor. One course. (3 graduate units.) *Knoerr*

**221L. Mycology.** Field and laboratory study of vegetative and reproductive structures of the fungi and slime molds. Methods of collection, isolation, propagation, and identification of the major orders as represented in local flora. Prerequisite: one year of biological science. One course. (4 graduate units.) *Johnson*

**225T, 226T. Special Problems.** Students with adequate training may do special work in the following fields. Credit to be arranged. (1-4 graduate units.)

1. Cytology: Bryology. *Anderson*
2. Genetics. *Antonovics*
3. Ecology. *Billings*
4. Phycology. *Blankley*
5. Genetics. *Boynton*
6. Ecology. *Christensen*
7. Lichenology. *Culbertson*
8. Physiology. *Hellmers*
9. Bacteriology; Mycology. *Johnson*
10. Physiology. *Naylor*
11. Anatomy and Morphology of Vascular Plants. *Philpott*
12. Phycology. *Searles*
13. Systematics of Flowering Plants. *Stone*



- 14. Ecology. *Strain*
- 15. Anatomy and Morphology of Vascular Plants. *White*
- 16. Systematics and Taxonomy of Vascular Plants. *Wilbur*

**233L. Microbiology.** Introduction to bacteriology, virology, cell biology, and immunology. Structure, metabolism, and growth of bacteria; the properties of bacterial and animal viruses; and basic immunology. (Also listed as Microbiology 233.) One course. (3 graduate units.) *Amos (Microbiology), Burns (Microbiology), Joklik (Microbiology), or Willett (Microbiology)*

**236S. Major Global Ecosystems.** Study of a single global ecosystem such as arctic-alpine, desert, tropical rainforest, grassland, or coniferous forest, including the place and effects of both primitive and modern man. One course. (3 graduate units.) *Billings*

**248. Introductory Biochemistry.** The chemistry of proteins, lipids, carbohydrates, and nucleic acids; metabolic interrelationships of these compounds. Prerequisite: Chemistry 151, one year of college physics (second semester may be concurrent), and Mathematics 32. (Also listed as Biochemistry 248). One course. (3 graduate units.) *Staff*

**250L,S. Plant Biosystematics.** Descriptive and experimental procedures used to assess systematic implications of vascular plant evolution. Laboratory, discussion, and field oriented problems. Prerequisites: basic courses in systematics and genetics. One course. (4 graduate units.) *Stone*

**252L. Plant Metabolism.** The physiochemical processes and conditions underlying the physiological processes of plants. Prerequisite: Botany 151L or equivalent; organic chemistry is recommended. One course. (4 graduate units.) *Naylor*

**256. Physiological Role of Minerals and Water.** Availability, uptake, transport, and function of minerals and water in plant growth. Prerequisite: Botany 151L or equivalent. One course. (3 graduate units.) *Hellmers*

**257S. Principles of Plant Distribution.** Interpretation of floristic and ecological plant geography. Prerequisite: Botany 146L or equivalent. One course. (3 graduate units.) *Billings*

**258. Physiology of Growth and Development.** Consideration of the internal factors and processes leading to the production of new protoplasm and its differentiation at the cellular, tissue, and organ level in plants. Lectures. Prerequisite: Botany 151L or equivalent; organic chemistry is recommended. One course. (3 graduate units.) *Naylor*

**258L. Physiology of Growth and Development.** See Botany 258. Lectures and laboratories. Half course. (2 graduate units.) *Naylor*

**259. The Environment.** Environmental principles; methods of obtaining and evaluating environmental data for ecological purposes with special attention to instrumentation and microclimate. Prerequisite: Botany 146L or equivalent. One course. (3 graduate units.) *Billings*

**265L. Physiological Plant Ecology.** The physiological approach to interpreting adaptation in plants, with emphasis on terrestrial seed plants. Prerequisites: Botany 146L and 151L or equivalent. One course. (3 graduate units.) *Strain*

**267L. Plant Community Ecology.** Concepts and methods of plant synecology. Introduction to the plant communities of North Carolina. Prerequisites:

Botany 142L and 146L or equivalent, and consent of instructor. One course. (3 graduate units.) *Christensen*

**268L.S. Quantitative Plant Ecology.** Experimental design, statistics, and analysis of pattern, population growth, diversity, community composition, and ecosystem dynamics. Prerequisites: statistics and Botany 146L or Botany 246L or equivalent and consent of instructor. One course. (3 graduate units.) *Christensen*

**280. Principles of Genetics.** Structure and properties of genes and chromosomes, and evolution of genetic systems. Prerequisites: introductory courses in biology, chemistry, and mathematics or equivalent. (Also listed as Botany 180, Zoology 180, and Zoology 280.) One course. (3 graduate units.) *Antonovics, Boynton, and Gillham (Zoology)*

**280L. Principles of Genetics.** Same course as 280 with laboratory included. One course (3 graduate units.) *Antonovics, Boynton, and Gillham (Zoology)*

**285S. Population Genetics.** A seminar and lecture course devoted to the analysis of the current literature in population genetics. Prerequisites: genetics or Botany 280 or equivalent and consent of instructor. (Also listed as Genetics 285.) One course. (3 graduate units.) *Antonovics*

**286. Evolutionary Mechanisms.** See course description for Zoology 286. (Also listed as Zoology 286 and under the University Program in Genetics). One course. (3 graduate units.) *Antonovics and H. Wilbur (Zoology)*

**287S. Quantitative Genetics.** Analysis of genetic variation in continuous traits. Models of continuous variation; genetic, environmental, and interaction components; genetic correlation; heritability estimation; selection response. Prerequisites: Botany 180 or Botany 280 or equivalent and consent of instructor. One course. (3 graduate units.) *Antonovics*

**295S, 296S. Seminar.** Credit to be arranged. *Staff*

## MARINE LABORATORY

Botany 202L, 204L, 211L, and 214L, are offered during the summer at the Duke University Marine Laboratory, Beaufort, North Carolina. The Department of Botany also participates in the spring semester program at the Marine Laboratory. Consult the *Bulletin of the Marine Laboratory* for further information.

## THE UNIVERSITY PROGRAM IN GENETICS

Courses offered by the Botany Department are an integral part of this inter-departmental program. Refer to the announcement in this *Bulletin* under Genetics, the University Program for descriptions of the other offerings.

## DEPARTMENTAL MAJOR

### For the A. B. Degree

*Prerequisites.* Introductory college biology or advanced placement in botany; two semesters of introductory chemistry (Chemistry 11-12) or advanced placement in chemistry; one semester of college mathematics or equivalent.

*Major Requirements.* A minimum of eight approved science courses in addition to prerequisites; at least five courses to be selected from the following: Botany 135L (Evolutionary Systematics) or 142L (Systematics), 145L (Plant Diversity), 146L (Ecology of Plants), 151L (Plant Physiology), 160L (Plant Anatomy) and 180 (Genetics). With the approval of the Director of Undergraduate Studies, one or two of the remaining science courses may be taken in a related depart-

ment. A student's program will be tailored to his interests and plans for the future.

### For the B.S. Degree

*Prerequisites.* Introductory college biology or advanced placement in botany; chemistry through organic; two terms of college mathematics or equivalent.

*Major Requirements.* Eight science courses as described under major requirements for the A.B. degree. A proficiency in reading German or Russian or two years of college German or Russian. One year of college physics or equivalent and a course in statistics are recommended. The emphasis in this preprofessional program will depend on the student's interests, and each program will be arranged on an individual basis.

### Interdepartmental Concentration

An interdepartmental program (e.g., in cell and molecular biology, physical biology, and marine biology) may be pursued instead of a departmental major. The appropriate director of undergraduate studies in botany or zoology will arrange administrative responsibility for such programs.

### Honors

The department offers a program for graduation with distinction in botany (see the section on Honors in this *Bulletin* for general requirements). The program is usually initiated during the junior year and involves participation in at least two semesters of independent study (Botany 191, 192). The research paper which results from this experience is submitted to a departmental committee for review, followed by a discussion of the paper with the student. On the basis of the quality of the research report and the student's performance in the discussion of it, the committee may recommend the student for graduation with distinction in botany.

## Canadian Studies Program

Professor Preston, *Director and Chairman of the Canadian Studies Committee*

The Program of Canadian Studies is designed to provide the student with an understanding of Canada and its problems and prospects. In the Canadian Studies Program, completion of which is imprinted on the official record upon graduation, a student must take four courses with Canadian content or the equivalent thereof (see below). These must include the Interdisciplinary Course, Canada: Problems and Issues of an Advanced Industrial Society, in which members of the Departments of History, Political Science, Economics, Sociology, and Romance Languages, and visiting Canadian specialists participate. It is recommended that students who do not have the equivalent of two years of college-level French should take French 181, 182, Intensive French.

The Program in Canadian Studies may be taken as part of a major in history, political science, or sociology as a supplement to any other major, as part of an interdepartmental concentration, or under Program II. For a description of the courses consult listings under Interdisciplinary Courses and the specified departments.

**Courses with Full Canadian Content.** The following courses count as one full course in the four required for the Canadian Studies option:

Economics 52 (one section). Competition, Monopoly, and Welfare. *Tower*  
Economics 116S. Economic Geography of Anglo-America. *Tuthill*

English 167. Canadian Literature in English. *Armitage*  
 French 125. The French of Canada. *Hull*  
 History 183. Canada from the French Settlement. *Preston*  
 Interdisciplinary Course 184. Canada: Problems and Issues of Advanced Industrial State. *Preston, Canadian Studies Committee Members, and Visiting Lecturers*  
 Political Science 195. Canadian Political Behavior. *Kornberg*  
 History 187. Canada and the United States: Their Diplomatic Relations. *Davis*

**Courses with a Significant Canadian Content.** Two of these will count as one course toward the four courses required for the Canadian Studies option:

Anthropology 118. Language, Law, and Politics. *O'Barr*  
 Anthropology 164. Peasantry and Peasant Movements. *Fox*  
 Anthropology 280S. Ethnicity and Acculturation. *Fox*  
 Economics 201S.6. Current Problems in International Monetary Arrangements. *Tower*  
 Economics 265S. International Trade and Finance. *Bronfenbrenner or Tower*  
 History 178. Diplomacy of the United States. *Davis*  
 History 297S. the British Empire in the Nineteenth Century. *Preston*  
 History 298S. The Commonwealth in the Twentieth Century. *Preston*  
 Law 230. International Law. *Grzybowski*  
 Political Science 135S. Comparative Legislative Behavior. *Mishler*  
 Political Science 275. American Party System. *Kornberg*  
 Political Science 293. Federalism. *Leach*  
 Sociology 142. Sociology of Mass Communication. *Smith*  
 Sociology 145. Urban Sociology. *Smith*

Information about other courses which would enrich a program in Canadian Studies may be obtained from the Director of Canadian Studies. A limited amount of financial aid for field work in Canada is available for undergraduates in the Canadian Studies Program.

## Chemistry

Professor Quin, *Chairman*; Professor Poirier, *Director of Undergraduate Studies*; Professor Bonk, *Supervisor of Freshman Instruction*; Professors Bradsher, Chesnut, Hobbs, Jeffs, Krigbaum, McPhail, Parham, Smith, Strobel, Wells, and Wilder; Visiting Professor Dawson; Associate Professors Henkens, Lochmüller, Palmer, and Porter; Adjunct Associate Professors Ghirardelli, Pitt, Rosenthal, and Spielvogel; Assistant Professors Baier, Baldwin, Crumbliss, Gutknecht, Neilson, and Shaw; Visiting Assistant Professor Sarneski

**10. Introductory Chemistry.** Emphasis on mathematical aspects of chemistry and topics such as structure and bonding. Closed to students having credit for Chemistry 11. Designed primarily for students needing further preparation before taking Chemistry 11, 12. Prerequisite: Mathematics 19 or the equivalent. One course. *Staff*

**11, 12. Principles of Chemistry.** The introductory course for students who intend to take any additional chemistry courses other than Chemistry 103. Chemistry 11 emphasizes stoichiometry and atomic and molecular structures. Chemistry 12 emphasizes thermodynamics, chemical kinetics, synthesis, and analysis. Laboratory work includes both qualitative and quantitative analysis. Two lectures, one recitation, and one four-hour laboratory. Prerequisites: one year of high school chemistry or Chemistry 10, and qualification for Mathematics 31. Two courses. *Bonk and Staff*



**103. Chemistry and Society.** Past discoveries and current challenges. Designed to provide a chemical background on which to base decisions regarding energy, radiation, pollution, drugs, contraceptives, food additives, vitamins, pesticides, etc. Primarily for students who do not intend to major in a natural science or to take further work in chemistry. One course. *Staff*

**117. Inorganic Chemistry.** Bonding, structures, and reactions of inorganic compounds studied through physical chemical concepts. Three lectures. Prerequisite: Chemistry 161. One course. *Crumbliss, Palmer, or Wells*

**132. Quantitative and Instrumental Analysis.** Practice in advanced quantitative analysis and in the use of chemical instrumentation. Theoretical and applied aspects of chemical and instrumental methods. Three lectures and four and one-half laboratory hours. Prerequisite: Chemistry 161. One course. *Gutknecht, Lochmüller, or Strobel*

**151, 152. Organic Chemistry.** The structures and reactions of the compounds of carbon. First semester laboratory: techniques of separation and structure determination. Second semester: organic reactions and preparations. Three lectures and four laboratory hours. Prerequisite: Chemistry 12 or consent of the Director of Undergraduate Studies. Chemistry 151 is a prerequisite for 152. Two courses. *Baldwin, Bradsher, Jeffs, Parham, Porter, Quin, and Wilder*

**151X, 152X. Organic Chemistry.** Paralleling Chemistry 151 and 152 but stressing topics of importance for those who anticipate majoring in chemistry. Three lectures and four laboratory hours. Prerequisites: Chemistry 12 and consent of instructor. Two courses. *Staff*

**152P. Preceptorial.** Preceptorial elective for students in Chemistry 152X. Prerequisites: Chemistry 151X or consent of instructor. *Staff*

**155. Spectral and Structural Study of Organic Compounds.** Advanced study of spectral properties and structural aspects of organic compounds and the influence of structure on reactivity. Laboratory work emphasizes the systematic identification of compounds by their spectral aspects and by their chemical properties. Three lectures and four and one-half laboratory hours. Prerequisite: Chemistry 152. One course. *Porter and Quin*

**161, 162. Physical Chemistry.** Fundamentals of theoretical chemistry illustrated by selected laboratory experiments. Two lectures, one recitation, and four laboratory hours. Prerequisites for 161: Chemistry 152, Physics 51, 52 and Mathematics 32. Prerequisites for 162: Chemistry 161 and either Mathematics 103 or consent of instructor. Two courses. *Chesnut, Henkens, Hobbs, Krigbaum, McPhail, Poirier, and Smith*

**175. Molecular Basis of Biological Processes.** A survey of the structures, reactions, and mechanisms of action of important biological molecules. Prerequisite: Chemistry 152. One course. *Shaw*

**191, 192. Independent Study.** Supervised reading and research. Open to students by consent of the department. Two courses. *Staff*

**193, 194. Independent Study.** Supervised reading and research. Open to students who have completed Chemistry 191, 192, and by consent of department. Two courses. *Staff*

**195S. Seminar.** Organic chemistry of biologically important compounds. Open to senior chemistry majors, or by consent of instructor. One course. *Baldwin*

**196S. Seminar.** Selected topics in physical chemistry of biological macromolecules. Prerequisites: Chemistry 161 and 175. One course. *Henkens*

**1975. Seminar.** Special topics in biological chemistry (e.g., immunochemistry, molecular biology). Prerequisite: Chemistry 161. Recommended: Chemistry 175. One course. *Staff*

**1985. Seminar.** Topics from various areas of chemistry, changing each semester. Open to senior chemistry majors or by consent of the Director of Undergraduate Studies. One course. *Staff*

### For Seniors and Graduates

**201. Molecular Spectroscopy.** Selected spectroscopic methods in the study of molecular structure. Symmetry and group theoretical basis for selection rules, theories of magnetic and optical resonance, and interpretation of spectra; examples from both inorganic and organic chemistry. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**203. Quantum Chemistry.** Basic principles of quantum and group theoretical methods. Topics include symmetry, a review of the fundamentals and the mathematical foundation of quantum theory. Emphasis on the application of molecular orbital theory to organic and inorganic systems. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**205. Structure and Reaction Dynamics.** Structure and mechanisms in organic and inorganic compounds, substitution reactions, linear free energy relations, and molecular rearrangements. Emphasis on the use of kinetic techniques to solve problems in reaction mechanisms. Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**207. Principles of Thermodynamics, Diffraction, and Kinetics.** Three lectures. Prerequisite: consent of department. One course. (3 graduate units.) *Staff*

**230. Environmental Oceanography.** Chemical, biological and geological aspects of pollution in the marine environment. The interaction of man with natural marine processes on shore lines and shelves. Application of marine science to compatible utilization of marine resources. Prerequisite: consent of instructor. Physical chemistry is recommended. (Also listed as Marine Sciences 230.) Given at Beaufort. One and one half courses. (6 graduate units.) *Baier and Staff*

**240. Chemical Oceanography.** Distribution, alteration, and transport of chemical species in the marine environment. *R/V Eastward* cruise to gather samples for evaluating chemical processes in the ocean. Prerequisite: consent of instructor. Physical chemistry is recommended. Includes lectures, laboratory work, and field trips. (Also listed as Marine Sciences 240.) Given at Beaufort. One and one half courses. (6 graduate units.) *Baier and Staff*

**275, 276. Advanced Studies.** (1) Analytical chemistry; (2) inorganic chemistry; (3) organic chemistry; and (4) physical chemistry. Open to especially well prepared undergraduates by consent of department. Two courses. (6 graduate units.) *Staff*

### DEPARTMENTAL MAJOR

Two different baccalaureate degrees are offered. The A.B. degree permits greater flexibility in allowing students to select an area of concentration while satisfying the junior-senior small group learning experience requirements through seminar courses (option one) or through independent study in chemistry or related departments (option two). Of special significance is the area of biological chemistry; under the direction of the Biological Chemistry Program

Coordinator, students may specialize in this area with either seminars (option three) or independent study in chemistry or related departments (option four) satisfying the junior-senior small group learning experience requirement. The B.S. degree program requires independent study and provides in-depth preparation for graduate study in chemistry.

### For the A.B. Degree

*Prerequisites.* Chemistry 11 and 12 or advanced placement; Mathematics 31, 32; Physics 51, 52.

*Major Requirements.* Chemistry 132, 151, 152, 161, *plus* one of the following options:

1. Two of the following: Chemistry 117, 155, 162, 175, 195S, 196S, 197S, 198S.
2. One of the following: Chemistry 117, 155, 162; *plus* Chemistry 191 and 192, or the equivalent in a natural science, in mathematics, engineering, or in a basic science department in the School of Medicine.
3. Chemistry 175, 195S or 197S, and 196S.
4. Chemistry 175, 196S; and Chemistry 191 and 192 in a biochemically related area, or the equivalent in a biological area, biomedical engineering, or basic science department in the School of Medicine.

*Recommended.* Computer Science 51, Mathematics 103 (for options 1 and 2); Chemistry 162 (for options 3 and 4); two semesters of a foreign language or the equivalent. Students planning graduate study are advised to take these recommended courses and to consult with advisors regarding appropriate additional courses.

### For the B.S. Degree

*Prerequisites.* Chemistry 11 and 12 or advanced placement; Mathematics 31, 32, 103; Physics 51, 52; two semesters of German or Russian, or the equivalent.

*Major Requirements.* Chemistry 117, 132, 151, 152, 155, 161, 162, 191, 192, and 203 or 207.

*Recommended.* Computer Science 51; Mathematics 104; Physics 161. Students planning graduate study in chemistry should consult with advisors regarding appropriate additional courses.

## Classical Studies

Professor Oates, *Chairman*; Assistant Professor Rigsby, *Director of Undergraduate Studies*; Professors Newton, Richardson, and Willis; Associate Professor Stanley; Assistant Professors Burian, Raschke, and Younger; Visiting Lecturer Levy

### GREEK

**1-2. Elementary Greek.** A study of grammar and an introduction to reading. Two courses. *Willis*

**63-64. Intermediate Greek.** Introduction to Greek prose and poetry. First semester: Plato's *Apology of Socrates* and two dialogues. Second semester: two plays of Euripides. Two courses. *Staff*

**87, 88. Sight Reading in Greek Prose.** Readings from easy Attic prose writers. Open to students who have completed one year of college Greek, or the equivalent with consent of instructor. Two hours per week. Two half courses. *Willis*

**105S. Seminar in Greek: Homer.** One course. *Stanley*

**106S. Seminar in Greek: The Lyric Poets.** One course. *Stanley*

**107S. Seminar in Greek: Tragedy.** One course. *Burian*

**108S. Seminar in Greek: Comedy.** One course. *Burian*

**109S. Seminar in Greek: The Historians.** One course. *Rigsby*

**110S. Seminar in Greek: The Orators.** One course. *Burian*

**117. Greek Prose Composition.** The character of the course is determined by the needs of the students enrolled. Half course. *Willis*

**181S, 182S. Greek Seminar.** An intensive introduction to the language and literature. Meets five times a week. Open only to students who have achieved proficiency in another language. Two courses each. *Staff*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors and seniors. Two courses. *Staff*

**193, 194. Directed Research in Greek.** Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses. *Staff*

**198S, 199S. Senior Seminar in Greek.** The seminar will change according to the interests of the instructor. Two courses. *Staff*

### For Seniors and Graduates

**200. Graduate Reading.** Open to qualified undergraduates by consent of the instructor. One course. (3 graduate units.) *Staff*

**203. Homer.** The *Iliad* and *Odyssey*; the problems of language and structure in the epic; present state of Homeric scholarship. One course. (3 graduate units.) *Levy or Stanley*

**205. Greek Lyric Poets.** Fragments of the early lyric poets; selected odes of Pindar and Bacchylides. One course. (3 graduate units.) *Burian*

**206. Aeschylus.** The *Oresteia*, with study of the form of *Agamemnon* and its place in the design of the trilogy. One course. (3 graduate units.) *Willis*

**208. Sophocles.** The Theban plays; the structure and style of Sophoclean tragedy. One course. (3 graduate units.) *Stanley*

**209. Euripides.** Representative tragedies in their political and philosophical context; analysis of dramatic form and texture. One course. (3 graduate units.) *Stanley*

**210. Aristophanes.** Origin and development of Greek comedy; representative plays of Aristophanes. One course. (3 graduate units.) *Burian*

**221. Early Greek Prose.** Greek prose in the fifth century from the Ionian scientists and logographers to Herodotus, Gorgias, Antiphon, and the Old Oligarch. One course. (3 graduate units.) *Willis*

**222. Thucydides.** The *History*; Thucydides' historical method and style. One course. (3 graduate units.) *Willis*

**223. Greek Orators I.** Early fourth century rhetoric, including Andocides, Lysias, and Isocrates. One course. (3 graduate units.) *Staff*

**224. Greek Orators II.** Aeschines' *Against Ctesiphon* and Demosthenes' *On*



*the Crown* in the light of fourth century political history and rhetorical development. One course. (3 graduate units.) *Willis*

**225. Plato.** Selected dialogues and related passages illustrating the development of philosophical topics and stylistic motifs. One course. (3 graduate units.) *Stanley*

**231. Hellenistic Poetry.** The principal lyric, elegiac, pastoral, and didactic poets of Alexandria; emphasis on Callimachus and Theocritus. One course. (3 graduate units.) *Stanley*

**241. Advanced Prose Composition.** Xenophon, Lysias, and other prose authors as models of style and practice in the writing of Attic prose. Half course. (1 graduate unit.) *Willis*

## LATIN

**1-2. Elementary Latin.** Study of the structure of the language (inflexions, vocabulary, syntax, and pronunciation). Second semester: reading in prose and poetry. Two courses. *Staff*

**63. Intermediate Latin.** Selected prose. One course. *Staff*

**64. Intermediate Latin: Vergil.** Readings from the *Aeneid*; lectures on the epic and its history and Vergil's style and technique. One course. *Staff*

**87, 88. Sight Reading in Classical, Medieval, and Renaissance Latin.** Offered especially for students in fields other than classical studies who wish to maintain and refresh their Latin. Two hours per week. (Open to students enrolled in other courses in Latin only on the recommendation of their instructors.) Two half courses. *Staff*

**100.** This number represents one course credit for advanced placement which will be awarded for scores of 4 or 5 on one or more of the College Board Advanced Placement tests in Latin. One course credit may be earned by a score of 3 if the student successfully completes one further semester of Latin.

**105S. Seminar in Latin: Ovid.** One course. *Newton*

**106S. Seminar in Latin: Lucretius.** One course. *Richardson*

**107S. Seminar in Latin: Lyric and Elegiac Poets.** One course. *Richardson*

**108S. Seminar in Latin: The Historians.** One course. *Staff*

**109S. Seminar in Latin: Comedy.** One course. *Richardson*

**110S. Seminar in Latin: The Novel.** One course. *Richardson*

**117. Latin Prose Composition.** The course content is determined by the needs of the students enrolled. One course. *Staff*

**181S, 182S. Latin Seminar.** An intensive introduction to the language and literature. Meets five times a week. Open only to students who have achieved proficiency in another language. Two courses each. *Staff*

**191, 192. Independent Study.** Directed reading and research. Open to qualified juniors and seniors. Two courses. *Staff*

**193, 194. Directed Research in Latin.** Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses: *Staff*

**198S, 199S. Senior Seminar in Latin.** The seminar will change according to the interests of the instructor. Two courses. *Staff*

## For Seniors and Graduates

**200. Graduate Reading.** Open to qualified undergraduates by consent of the instructor. One course. (3 graduate units.) *Newton or Stanley*

**201. The Verse Treatise.** The genre of didactic poetry; emphasis on Lucretius' *De Rerum Natura*, Vergil's *Georgics*, and Ovid's *Ars Amatoria*; attention to Cicero's *Aratea*, the *Astronomica* of Manilius, Horace's *Ars Poetica*, and Ovid's *Fasti*. One course. (3 graduate units.) *Newton or Richardson*

**202. Roman Satire.** A survey of the genre with concentration on Horace, Juvenal, and Persius. One course. (3 graduate units.) *Richardson*

**203. Epic: Vergil.** The *Aeneid*. One course. (3 graduate units.) *Newton*

**204. Epic: Lucan and Statius.** The development of the Roman epic in the Silver Age. One course. (3 graduate units.) *Richardson*

**207. The Prose Epistle.** The letter as a vehicle of communication and as a literary form. One course. (3 graduate units.) *Richardson*

**208. The Epistle in Verse.** The letter as a literary form; reading in the *Epistles* of Horace, the *Heroides* of Ovid, and Statius. One course. (3 graduate units.) *Staff*

**209. Fragments of Early Latin.** The remains of Latin poetry of the third and second centuries B.C., from Livius Andronicus to Lucilius, with emphasis on the epic and drama of Ennius. One course. (3 graduate units.) *Stanley*

**210. Lyric and Occasional Poetry.** Shorter verse forms: epigram, pastoral, song, and panegyric. One course. (3 graduate units.) *Staff*

**211. Roman Oratory I.** The literary history and criticism of Roman oratory. One course. (3 graduate units.) *Richardson*

**212. Roman Oratory II.** A continuation of Latin 211. One course. (3 graduate units.) *Staff*

**221. Medieval Latin I.** Latin literature of late antiquity, from Prudentius to the Carolingian Revival. One course. (3 graduate units.) *Newton*

**222. Medieval Latin II.** Literature in Latin from Charlemagne to the Renaissance. One course. (3 graduate units.) *Newton*

**225. Latin Paleography.** Latin book hands from the Roman Empire to the Italian Renaissance. One course. (3 graduate units.) *Newton*

**241. Advanced Latin Composition.** Experiments in imitation of the great Latin prose styles and introduction to the composition of verse. Half course. (1 graduate unit.) *Richardson*

**250. Teaching Latin.** Objectives, methods, and problems; the study of textbooks, programs, and related materials. One course. (3 graduate units.) *Staff*

## CLASSICAL STUDIES

**110. Greek Civilization.** The culture of the ancient Greeks from the Bronze Age to Alexander the Great: art, literature, history, philosophy, and religion. One course. *Raschke*

**120. Roman Civilization.** The culture of the ancient Romans from their beginnings to Constantine: art, literature, history, philosophy, and religion. One course. *Raschke*

- 51. Greek Literature in English Translation.** Reading in translation of major Greek authors, with emphasis on the Homeric epic and the Attic drama. One course. *Rigsby*
- 52. Latin Literature in English Translation.** Reading in translation of major Roman authors, such as Plautus, Terence, Vergil, Horace, Ovid, Petronius, Juvenal, Tacitus, and Apuleius. One course. *Rigsby*
- 53. Greek History.** The political and intellectual history of the Hellenes from earliest times to the death of Alexander the Great. (Also listed as History 53.) One course. *Raschke*
- 54. Roman History.** The Roman Republic and Empire to the Council of Nicaea. (Also listed as History 54.) One course. *Raschke*
- 55. Greek Art and Archeology.** Greek architecture, sculpture, and painting from the Bronze Age to the classical period. Study of objects in the Duke Classical Collection is included. One course. *Younger*
- 56. Roman Art and Archeology.** Rome's achievement in architecture and decoration, portraiture, and relief sculpture; from the Villanovans to the Antonine emperors. One course. *Younger*
- 57S, 58S. Seminar in Classical Studies.** Aspects of the history, art, and literature of classical Greece and Rome. For freshmen and sophomores. Two courses. *Staff*
- 114. Greek Drama.** Readings in English translation of Aeschylus, Sophocles, Euripides, Aristophanes, and Menander. One course. *Burian*
- 115. The Classical Tradition.** The notion of the "classical" from the creation of the archetype to the present. (Also listed as Comparative Literature 115.) One course. *Burian*
- 116. Greek Literature of the Roman Empire.** The intellectual world of late antiquity; readings in translation of pagan and early Christian writers. (Also listed as Comparative Literature 116.) One course. *Rigsby*
- 117. Ancient Mythographers.** Myth in classical and medieval writers from Hesiod to Boccaccio. (Also listed as Comparative Literature 117.) One course. *Newton*
- 133. Early Greece and the Near East.** Political, social, and intellectual developments from the world of Homer to the Persian Wars. One course. *Oates*
- 134. The Athenian Empire.** Imperial democracy at Athens and its consequences for the *polis*. (Also listed as History 125.) One course. *Oates*
- 135. Alexander the Great.** His career and the effects of his conquests. (Also listed as History 126.) One course. *Oates*
- 136. The Hellenistic Kingdoms.** The Greek world from the death of Alexander in 323 B.C. to the end of the second century B.C. (Also listed as History 127.) One course. *Oates*
- 137. The Roman Revolution.** Rome from the time of the Gracchi (133 B.C.) to the death of Augustus (14 A.D.). One course. *Oates*
- 138. The Decline and Fall of Rome.** Rome from the death of Commodus to the accession of Constantine. One course. *Oates*
- 143. The Ancient Cities of Greece.** The *polis* as a physical and societal complex; urban problems and their solutions through the centuries. A different

Greek city that has been extensively excavated and well published is chosen as representative of each century and examined in detail. One course. *Richardson*

**144. Ancient Cities: Rome and Her Colonies.** As a metropolis and a cosmopolis; the sources and uses of significant architectural and urbanistic ideas; the city government and organization of the megalopolis; Roman colonies throughout the Empire. One course. *Richardson*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors and seniors. Two courses. *Staff*

**193, 194. Directed Research in Classical Studies.** Research culminating in the writing of one longer or two shorter papers as partial fulfillment of the requirements for graduation with distinction. Open only to senior majors. Two courses. *Staff*

**195S, 196S. Junior Seminar in Classical Studies.** The seminar will change each year according to the interest of the instructor. Two courses. *Staff*

### For Seniors and Graduates

**231. Greek Sculpture.** Techniques and styles of the major schools and personalities in archaic, classical, and Hellenistic free-standing and architectural sculpture. One course. (3 graduate units.) *Younger*

**232. Greek Painting.** Techniques and style in the various media; emphasis on the problems of chronology, attribution, and iconography of Attic pottery. One course. (3 graduate units.) *Younger*

**235. Roman Architecture.** Significant monuments chosen to exemplify the Roman genius in building in the late Republic and early Empire. One course. (3 graduate units.) *Richardson*

**236. Roman Painting.** Roman pictorial art with concentration on the wall paintings from Campania. Investigation of techniques, iconography, and the use of pictures in decoration. One course. (3 graduate units.) *Richardson*

**253. Greece to the Orientalizing Period.** One course. (3 graduate units.) *Rigsby*

**254. The Age of the Tyrants and the Persian Wars.** One course. (3 graduate units.) *Oates*

**255. The Age of Pericles.** One course. (3 graduate units.) *Oates*

**256. The Fourth Century through Alexander.** One course. (3 graduate units.) *Oates*

**257. Social and Cultural History of the Hellenistic World from Alexander to Augustus.** One course. (3 graduate units.) *Rigsby*

**258. Social and Cultural History of the Graeco-Roman World.** One course. (3 graduate units.)

**260. The History of Rome to 146 B.C.** One course. (3 graduate units.) *Staff*

**261. The Roman Revolution, 146-30 B.C.** One course. (3 graduate units.) *Oates*

**262. Rome under the Julio-Claudians.** One course. (3 graduate units.) *Raschke*

**263. From the Flavian Dynasty to the Severan.** One course. (3 graduate units.) *Raschke*



**264. From Septimius Severus to Constantine.** One course. (3 graduate units.)  
Staff

**270. The Rise of the Hellenistic Kingdoms.** One course. (3 graduate units.)  
Oates

**271. The Hellenistic World, 250-31 B.C.** One course. (3 graduate units.)  
Oates

## DEPARTMENTAL MAJOR IN GREEK

*Prerequisite.* Greek 2 or equivalent.

*Major Requirements.* Six courses in Greek above the level of Greek 2. In addition, students will be required to pass an examination testing proficiency in Greek composition or to complete Greek 117.

*Related Work.* Greek majors normally take at least four semesters of Latin, and are also encouraged to take course work in ancient history and/or archeology. The nature and amount of related work, however, may vary with the student.

## DEPARTMENTAL MAJOR IN LATIN

*Prerequisite.* Latin 64 or equivalent.

*Major Requirements.* Six courses in Latin above the level of Latin 64. In addition, students will be required to pass an examination testing proficiency in Latin composition or to complete Latin 117.

*Related Work.* Latin majors normally take at least four semesters of Greek, and are also encouraged to take course work in ancient history and/or archeology. The nature and amount of related work, however, may vary with the student.

## DEPARTMENTAL MAJOR IN CLASSICAL STUDIES (ANCIENT HISTORY AND ARCHEOLOGY)

*Prerequisites.* Classical Studies 110, 120; 51, 52; 53, 54; 55, 56; or 57S, 58S.

*Major Requirements.* Eight courses at the 100-level or above, including two courses of seminar or independent study, or a combination of these. Reading knowledge of Latin or Greek to the level of Latin 64 or Greek 64. Two courses in the ancient languages above that level may be counted toward the major.

Majors in either Greek or Latin who contemplate graduate work are reminded of the necessity for competence in both languages for all higher degrees and of the requirement for a reading knowledge of French and German.

Majors are eligible for nomination to a term of one semester during their junior year at the Intercollegiate Center for Classical Studies in Rome, of which Duke University is a founding member, at a cost comparable to that of a semester at Duke. Financial arrangements are made through the University, and students may apply for scholarship assistance. Courses in Greek, Latin, ancient history and archeology taken at the center are counted toward the major requirements. For further information, see section on Study Abroad.

The department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

## Comparative Area Studies: Africa, Asia, Latin America, and Russia

Assistant Professor Valenzuela, *Director*

The undergraduate major in Comparative Area Studies offers a Bachelor of

Arts degree to students interested in the interdisciplinary study of societies and cultures of a particular region of the world, while at the same time concentrating in an academic discipline. Students in the program are currently studying Latin America, Africa, the Middle East, Russia, South Asia, and East Asia. The major draws its offerings from existing courses taught by over forty Duke professors in a dozen cooperating departments. In addition to its director, the program is administered by an advisory committee of faculty members representing the various areas and cooperating departments.

## THE MAJOR

In consultation with the Director, the student must identify a primary disciplinary and area focus. A student wishing to specialize in an area not indicated in the categories of courses that follow will be required to submit a proposed course of study to the advisory committee for approval. Selection of area and discipline is normally done by the end of the sophomore year.

A special feature of the major is provision for granting credit to students who wish, and who are qualified, to study abroad in the area of choice; or who undertake intensive summer language programs in the United States.

*Prerequisites.* 1. Any two of the following introductory-level courses emphasizing comparative approaches: History 175, 176 (Introduction to Asia, Africa, and Latin America); Anthropology 94 (Elements of Cultural Anthropology); or Anthropology 99 (Cultural Anthropology for Social Science Majors), but not both 94 and 99; Religion 57 (Introduction to the History of Religions); Political Science 92 (Introduction to Comparative Politics); 2. Four semester-courses of which two shall be in a language of the area, and the other two may be a continuation of the language or two of the following: literature of the area in translation, or general linguistics. The Director should be consulted for specific approval of language choice.

*Major Requirements.* 1. Discipline Courses. Four semester-courses in a discipline (either social science or humanities). 2. Area Courses. Four semester-courses in the geographic area of special interest, and two in another one of the areas included in the major. 3. Seminar. In the senior year, one-semester interdisciplinary seminar, bringing together a number of major themes for comparative treatment.

The following courses may be taken for credit as area courses. Others may be selected with the approval of the Director. Courses in language instruction are not included in this list. For a complete description consult the listing under the appropriate department.

## Africa

Anthropology 125 (Peoples of the World: Africa); 134 (Political Anthropology); 222S (Topics in African Anthropology).

Black Studies 113 (African Philosophy); 150 (Third World Literature).

Economics 114 (Economic Geography of Africa); 214 (Geonomics: Geography and Contemporary Economics of Africa); 219 (Economic Problems of Underdeveloped Areas).

History 115-116 (History of Africa); 117-118 (European Imperialism and Colonialism); 195Y-196Y (Issues in the History of Tropical Africa); 255S-256S (Problems in African History).

Political Science 161S (Comparative Government and Politics: Africa); 163 (Women in Developing Societies); 171 (Political Processes in Traditional and Modern Africa); 280 (Comparative Government and Politics: Sub-Saharan Africa).

Religion 113 (African Philosophy); 299 (World Religions and Social Change).  
Sociology 136 (Sociology of Modern Africa).

## **East Asia**

Chinese 135, 136 (Introduction to Modern Chinese Literature); 141 (Chinese Literature in Translation).

Economics 120 (Economic Geography of Asia); 232 (Economic History of Japan).

History 141 (Man and Society in Traditional China); 142 (China: The Roots of Revolution); 143-144 (History of Modern Japan); 177 (The People's Republic of China); 195-196G (Nationalism and Communism in the Far East); 195S-196S (Processes of Development in Modern Japan: 1800 to the Present); 207S-208S (Seminar in Modern East Asia: Problems and Literature); 260 (Economic History of Japan).

Japanese 155-156 (Introduction to Modern Japanese Literature); 161 (Modern Japanese Fiction in Translation).

Political Science 168 (Comparative Government and Politics: Northeast Asia I); 169 (Comparative Government and Politics: Northeast Asia II); 211, 212, (Comparative Japanese Politics).

Religion 141 (Religions of China and Japan); 149 (Buddha and Buddhism); 283 (Religions of East Asia).

## **Latin America**

Anthropology 124 (Peoples of the World: American Indian).

Art 149 (Pre-Columbian Art and Archeology); 150 (Latin American Art) 241 (Problems in Latin American Art); 249 (Problems in Pre-Columbian Art and Archeology).

History 128 (The United States and Latin America); 131 (Mexico and the Caribbean from the Wars of Independence to the Present); 132 (Major South American Nations: 1850 to the Present); 152 (Modern Mexico); 155-156 (Modern Latin America); 173, 174 (History of Spain and the Spanish Empire from Late Medieval Times to the Present); 195X-196X (Problems in Latin American History); 265S-266S (Problems in Modern Latin American History).

Political Science 151 (Introduction to Latin American Politics); 152S (Authoritarianism and Revolution in Latin America); 253 (Comparative Politics and the Study of Latin America).

Spanish 155 (Spanish American Short Fiction); 157 (Latin American Literature in Translation); 255-256 (Modern and Contemporary Latin American Literature).

Sociology 251 (Sociology of Modernization).

## **Middle East**

Anthropology 129 (Peoples of the World: Middle East).

History 188 (Middle East, 1789 to the Present).

Religion 57 (Introduction to History of Religions); 136 (Contemporary Jewish Thought); 147 (Mohammed and the Qur'an); 284 (The Religion and History of Islam).

## **Russia**

Economics 293 (Soviet Economic History); 294S (Soviet Economic System).

History 119-120 (History of Socialism and Communism); 161-162 (History of Russia); 201S-202S (Change in Prerevolutionary Russia); 261-262 (Problems in Soviet History); 195J-196J (History of International Socialism to the First World

War); 195T-196T (Problems in the History of Russia before 1917).

Political Science 117 (Comparative Legal Systems); 162 (Comparative Government and Politics: Communist and Socialist Political Systems); 165 (Government and Politics of the Soviet Union); 168 (Soviet Foreign Relations); 228 (Soviet Public International Law).

Slavic Languages and Literature 101-102 (Russian Literature and Culture Through the Nineteenth Century); 124 (Masters of Russian Short Fiction); 184 (Soviet Writers of the 60's); 188 (Solzhenitsyn and the World of Soviet Concentration Camps); 201-202 (The Novelists of Nineteenth Century Russia); 207 (Soviet Literature and Culture); 214 (The Poles: Literature and Culture 1940-1970).

## South Asia

Anthropology 101-102 (Introduction to the Civilization of Southern Asia); 128 (Peoples of the World: Asia); 134 (Political Anthropology); 141 (Peoples of the World: Southeast Asia); 142 (Peoples of the World: South Asia); 220 (Society and Culture in India).

Hindu-Urdu 171-172 (Studies in Indian Literatures); 173-174 (Literature and Revolution).

Economics 120 (Economic Geography of Asia).

Education 218 (Comparative and International Education: Developing Countries); 219 (Comparative and International Education: South Asia).

History 101-102 (Introduction to the Civilization of Southern Asia); 148 (History of India and Pakistan, 1707 to the Present); 147 (History of India to 1707); 195W (Studies in Modern Indian History); 248 (History of Modern India and Pakistan, 1857 to the Present); 297 (The British Empire in the Nineteenth Century); 298 (The Commonwealth in the Twentieth Century).

Political Science 101-102 (Introduction to the Civilization of Southern Asia); 148 (Arab and non-Arab Muslim World); 155 (Problems of Political Development in the New States); 180S (Comparative Government and Politics: South Asia I); 181 (Comparative Government and Politics: South Asia II); 250 (Comparative Government and Politics: South Asia).

Religion 140 (Religions of India); 148 (Introduction to the Civilization of Southern Asia); 149 (Buddha and Buddhism); 217 (Islam in India); 284 (The Religion and History of Islam); 285 (The Vedic Tradition: Compilation and Interpretation); 286 (Religious Trends in Modern India); 287 (The Scriptures of Asia); 288 (Buddhist Thought and Practice); 289 (World Religions and Social Change).

## Comparative Literature

Professor Wardropper (Romance Languages), *Chairman of the Committee on Comparative Literature*; Professors Anderson (English), Fowlie (Romance Languages), Jantz (Visiting Professor, German), Krynski (Slavic Languages), Newton (Classical Studies), Reiss (English), and Tetel (Romance Languages); Associate Professors Clubbe (English), Harwell (English), Jezierski (Slavic Languages), Reardon (English), and Rolleston (German); Assistant Professors Burian (Classical Studies), Rigsby (Classical Studies), and Shonek (Hindi-Urdu)

**100. Introduction to Comparative Literature.** History, prevailing approaches, methods of investigation, problems of literary influence and translation; European and American movements and genres. Occasional guest lecturers. One course. *Staff*

**112. English Literature of the Middle Ages.** (Also listed as English 112.) One course. *Reiss*



**115. The Classical Tradition.** (Also listed as Classical Studies 115.) One course. *Burian*

**116. Greek Literature of the Roman Empire.** (Also listed as Classical Studies 116.) One course. *Rigsby*

**117. Ancient Mythographers.** (Also listed as Classical Studies 117.) One course. *Newton*

**124. Continental Humanism.** (Also listed as Romance Languages 124.) One course. *Tetel*

**151. Theory and Form of Tragedy.** (Also listed as French 151.) One course. *Fowlie*

**152. Andre Gide: The Art of Fiction and Autography.** (Also listed as French 152.) One course. *Fowlie*

**160. An Approach to Comedy.** (Also listed as Romance Languages 160.) One course. *Wardropper*

**165. Readings in Scandinavian Literature.** (Also listed as English 165.) One course. *Anderson*

**169. Modern European Drama.** (Also listed as English 169.) One course. *Reardon*

**171, 172. Studies in Indian Literatures.** (Also listed as Hindi-Urdu 171, 172.) Two courses. *Shonek*

**173, 174. The Slavs: Literature and Culture.** (Also listed as Slavic Languages and Literatures 173, 174.) Two courses. *Krynski*

**186. Non-Russian Slavic Literatures.** (Also listed as Slavic Languages and Literature 186.) One course. *Jezierski*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified students in the junior year, by consent. Two courses. *Staff*

**193, 194. Independent Study.** Directed readings and research. Open only to qualified students in the senior year, by consent. Two courses. *Staff*

### For Seniors and Graduates

**201, 202. Romanticism.** Studies in the origin, rise, and development of the Romantic Movement in the chief literatures of the Western world. The approach is comparative; the principal emphasis will be on England, France, and Germany, with some reference to other countries. Selected subjects will occasionally be covered by speakers from various departments of the University. Two courses. (6 graduate units.)

**203, 204. Realism and Symbolism.** Comparative studies in the literatures of England, France, Germany, Russia, the Scandinavian countries, Spain, and Italy, tracing the decline of romantic individualism and the reappraisal of man's significance against the social background. Selected subjects will occasionally be covered in lectures by speakers from various departments of the University. Two courses. (6 graduate units.)

**205. The Modern: Problems of Definition, History, and Language.** The self-consciousness of literature in the "age of criticism." Representative twentieth century texts discussed as authorial confrontations with normative modern masters (Baudelaire, Flaubert, Rimbaud, Dostoevsky, Nietzsche). One course. (3 graduate units.) *Rolleston*

**206. Autobiography.** Origins and developments in the chief European literatures including autobiographies of St. Augustine, Montaigne, Bunyan, Rousseau, Goethe, Carlyle, Nietzsche, Yeats, and Jung. One course. (3 graduate units.) *Clubbe*

**220S. Comparative Literature Seminar.** Topics vary. One course. (3 graduate units.) *Jantz*

**223. Structuralism and the New Criticism.** (Also listed as French 223.) One course. (3 graduate units.) *Fowlie*

**285. Literary Criticism.** (Also listed as English 285.) One course. (3 graduate units.)

## MAJOR IN COMPARATIVE LITERATURE

*Prerequisite.* A reading knowledge of at least one foreign language; English 55, 56 or the equivalent.

*Major Requirements.* (1) Reading knowledge of a second foreign language; (2) three courses in a single foreign literature, to be read in the original (committee approval required); (3) Comparative Literature 100 and two other comparative literature courses, at least one of which must be a 200-level course.

The Committee on Comparative Literature will assist the major in creating a program having unity and direction and will also advise him of pertinent conference courses and seminars offered each year in the various literature departments. Inquiries may be directed to Professor Wardropper, Chairman of the Committee on Comparative Literature, 309 Languages Building.

## Computer Science

Professor Loveland, *Chairman*; Professor Gallie, *Director of Undergraduate Studies*; Professors Marinos, Naylor, Nolte, and Woodbury; Associate Professors Hammond, Patrick, and Starmer; Adjunct Associate Professor Williams; Assistant Professors Biermann, Foster, Gerhart, Ramm, and Trivedi

The Department of Computer Science provides courses on the concepts of computing and computers, their capabilities and uses. Most courses require the student to make extensive use of one or more of the available computers as a problem-solving instrument. Students who wish to take a single introductory course in computer science, as part of their general education, usually elect Computer Science 51.

**42. Introduction to Digital Systems.** (Also listed as Electrical Engineering 42.) One course. *Marinos*

**51. Introduction to Digital Computation.** Flow charts; an assembly language; program structures, subroutines, data structures, arrays, polynomials; an algorithmic language; numerical linear algebra, matrix inversion, linear programming and least-squares techniques. One course. *Gallie and Staff*

**51P. Preceptorial.** Elective preceptorial for students enrolled in Computer Science 51. *Staff*

**51X. Introduction to Digital Computation.** Same as Computer Science 51. (For students who have had previous programming experience.) One course. *Staff*

**71. Discrete Systems Analysis.** (Also listed as Biomedical Engineering 71.) One course. *Pilkington*

**100S. Computer Programming Techniques.** Advanced programming techniques and applications. Prerequisite: Computer Science 51. One course. *Gallie*

**150. Computers and Programming.** Computer structure, machine language, instruction execution, addressing techniques, and digital representation of data. Computer systems organization, logic design, micro-programming, and interpreters. Symbolic coding and assembly systems, macro definition and generation, and program segmentation and linkage. Prerequisite: Computer Science 51. One course. *Staff*

**150P. Preceptorial.** Elective preceptorial for students enrolled in Computer Science 150. *Staff*

**152. List Processing and Data Structures.** Linear lists such as stacks, queues, dequeues, circular lists, and doubly linked lists; trees; multilinked structures; dynamic storage allocation. Exercises may require use of an assembly language. Prerequisite: Computer Science 51. (Also listed as Mathematics 152.) One course. *Staff*

**152P. Preceptorial.** Elective preceptorial for students enrolled in Computer Science 152. *Staff*

**157. Introduction to Switching Theory.** (Also listed as Electrical Engineering 157.) One course. *Marinos*

**161. Numerical Solution of Ordinary Differential Equations.** (Also listed as Mathematics 161.) One course. *Murray*

**163. Data Analysis.** Elements of probability and statistics, acquisition of data, maintenance of data bases, computation and display of statistical summaries. Prerequisites: Computer Science 51 and Mathematics 31 or equivalent. One course. *Woodbury*

**191, 192. Independent Study.** Directed reading and research for qualified juniors. Prerequisite: consent of instructor and Director of Undergraduate Studies. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research for qualified seniors. Prerequisite: consent of instructor and Director of Undergraduate Studies. Two courses. *Staff*

## For Seniors and Graduates

**200. Programming Methodology.** Practical and theoretical topics including structured programming, specification and documentation of programs, debugging and testing strategies, choice and effective use of programming languages and systems, psychology of computer programming, proof of correctness of programs, analysis of algorithms, and properties of program schemata. Prerequisite: Computer Science 150 and 152. One course. (3 graduate units.) *Gerhart*

**201. Programming Languages.** Information binding, data structures and storage, control structures, recursion, execution environments, input/output; syntax and semantics of languages; study of PL/I, Fortran, Algol, APL, LISP, SNOBOL, and SIMULA; exercises in programming. Prerequisite: Computer Science 200. One course. (3 graduate units.) *Gerhart*

**203. Random Signals and Noise.** (Also listed as Electrical Engineering 203.) One course. (3 graduate units.) *Kerr or Nolte*

**205. Signal Detection and Extraction Theory.** (Also listed as Electrical Engineering 205.) One course. (3 graduate units.) *Nolte*

**208. Digital Computer Design.** (Also listed as Electrical Engineering 208.) One course. (3 graduate units.) *Marinos or Owen*

**210. Image Processing.** Digital image transducers and processing algorithms; special purpose filters and tracking algorithms as applied to both binary and multi-gray level images; transducer hardware such as flying spot scanners and image dissectors. One course. (3 graduate units.) *Starmer*

**215. Artificial Intelligence.** Heuristic versus algorithmic methods; programming of games such as chess; theorem proving and its relation to correctness of programs; readings in simulation of cognitive processes, problem-solving, semantic memory, analogy, adaptive learning. Prerequisite: Computer Science 152 or consent of instructor. One course. (3 graduate units.) *Biermann*

**221. Numerical Analysis I.** Error analysis and interval arithmetic, interpolation and polynomial approximation methods, numerical differentiation and integration, solution of simultaneous linear equations and matrix inversion, real and complex roots of nonlinear equations. Prerequisite: knowledge of an algorithmic programming language and intermediate calculus. (Also listed as Mathematics 221.) One course. (3 graduate units.) *Gallie or Patrick*

**222. Numerical Analysis II.** Calculation of eigenvalues and eigenvectors, numerical methods for solving ordinary differential equations, partial differential equations, and integral equations. Prerequisite: Computer Science 221 or equivalent. (Also listed as Mathematics 222.) One course. (3 graduate units.) *Patrick or Utku*

**223. Numerical Optimization.** Numerical methods for finding minima of functions of several or many variables, with and without conditions of constraint. Prerequisite: Computer Science 221 or equivalent. One course. (3 graduate units.) *Staff*

**225. Mathematical Foundations of Computer Science I.** Introduction to basic concepts and techniques used in mathematical models of computation. Elements of the predicate calculus; applications to automatic theorem proving and verification of programs. Notions of computable sets, functions, algorithmically unsolvable problems. Regular and context-free formal languages and the machines that define them. Prerequisite: four semesters of college mathematics. One course. (3 graduate units.) *Loveland*

**226. Mathematical Foundations of Computer Science II.** Basic concepts and techniques used in the modeling of systems. Elements of probability, statistics, queuing theory, linear programming, linear systems, and error analysis. Prerequisite: four semesters of college mathematics. One course. (3 graduate units.) *Foster*

**231. Introduction to Operating Systems.** Characteristics and components of operating systems and methods for their implementation. Program linkage and relocation, job scheduling, resource allocation and interrupt handling, input/output control systems, on-line file structures, communication, time sharing and real time systems. Case studies of existing systems. Prerequisite: Computer Science 152. One course. (3 graduate units.) *Foster or Ramm*

**232. Metaprograms.** Programs which process programs: compilers, interpreters, and assemblers. Syntax and semantics of programming languages. One course. (3 graduate units.) *Gallie*

**241, 242. Information Organization and Retrieval.** Structure, analysis organization, storage, searching, and retrieval of information. Emphasis on structure of files, dictionary construction and look-up, search and matching pro-



cedures, indexing, file maintenance and methods for user interaction with the automated system. Programming experience included. Prerequisite: Computer Science 152. Two courses. (6 graduate units.) *Hammond*

**244. Computer Simulation Models of Economic Systems.** (Also listed as Economics 244.) One course. (3 graduate units.) *Naylor*

**250. Pattern Analysis, Clustering, and Typology.** Algorithms for clustering and classification with special emphasis on graphical methods, clique enumeration. Discriminant analysis, finite mixtures estimation, and error analysis. Sequential methods for feature selection and for pattern learning. Typology (nosology) and formal diagnostics, learning (sequential estimation) of functional relations. Prerequisite: consent of instructor. One course. (3 graduate units.) *Woodbury*

**251. Computer Science for Teachers.** An introduction to digital computation which concentrates on computer instruction in the high school and on the employment of computer processes in instruction and school administration. Prerequisite: a year of basic mathematical analysis at college level. Summer session. One course. (3 graduate units.) *Staff*

**265. Advanced Topics in Computer Science.** One course. (3 graduate units.) *Staff*

## DEPARTMENTAL MAJOR

### The B.S. Degree

*Prerequisites.* Computer Science 51; Mathematics 31, 32, 103, 104.

*Major Requirements.* Computer Science 150, 152, three of the following: 157, 163, 200, 215, 221, 225, 231, 232, 241; and Mathematics 135 or 183. If Mathematics 135 is elected, it is strongly recommended that it be followed by Mathematics 136 or 206. The student must take enough additional courses so that he has completed at least five courses (excluding Mathematics 103, 104) at the 100-level or above in one department other than computer science or in an approved area. A list of areas, such as the zoology-chemistry combination often chosen by pre-medical students, which have been approved by the department may be obtained from the Director of Undergraduate Studies.

*Honors.* Any student who is qualified (see the section on Honors in this *Bulletin* for general requirements) may undertake work leading to a degree with distinction in computer science by applying to the Director of Undergraduate Studies. The candidate must complete a substantial project, suitably documented, or a distinguished paper on which he or she will be examined orally by a committee of three faculty members.

Students planning to do graduate work will probably find a reading knowledge of at least one foreign language useful. Students who expect to do their graduate work in computer science should try to include Computer Science 221 and modern algebra in their course of study.

## Drama

Assistant Professor Clum (English), *Director of Program in Drama, and Chairman of the Interdisciplinary Committee on Drama*; Professors Cordle (French), Fowlie (French), Burian (Classical Studies), and Wardropper (Spanish); Associate Professors Jezierski (Slavic Languages), Michalak (English), Reardon (English),

and Stewart (Romance Languages); Assistant Professor Alt (German); Artists-in-residence Parker and Fowlkes

No major is offered in drama, but a course program including the basic courses in practical theater listed below should prepare one for further study on the graduate level. These courses should also serve to develop the skills of the interested amateur.

Note that the courses listed under Practical Theater are skill courses and, as such, do not satisfy distributional requirements.

## PRACTICAL THEATER

**101. Acting.** Basic acting skills; diction, movement, improvisation, interpretation. One course. *Staff*

**102. Advanced Acting.** Advanced work in interpretation and scene study. Prerequisite: Drama 101. *Staff*

**103. Directing.** Basic training in casting, blocking, and interpretation. One course. *Staff*

**104. Stagecraft.** An introduction to technical aspects of play production: scenery, lighting, properties, make-up, and costuming. Laboratory work coordinated with productions of Duke Players or Summer Theater at Duke. One course. *Parker*

**105. Educational Theater.** Training in producing and directing junior high and high school productions: play selection, casting, publicity, ticket sales, basic directing. One course. *Clum*

**106. Scene Design.** General principles of visual design as applied to scenery for the theater. Instruction in standard techniques of planning and rendering scene designs. One course. Prerequisite: Drama 104 or consent of the instructor. *Parker*

**191-194. Independent Study.** Intensive study or special projects in theater history or practical theater approved by the Interdisciplinary Committee on Drama. One course. *Staff*

See also English 130, Play Production (Michalak).

## CRITICISM

**180S. Drama Criticism.** Readings in representative criticism. Role of the critic. Experience in writing drama criticism. One course. *Clum*

## THEATER HISTORY

### English

119. History of the Theater. *Michalak*

## DRAMATIC LITERATURE

### Classical Studies

114. Greek Drama. *Burian*

### English

22S. Studies in Drama. *Staff*

129. English Drama from the Middle Ages through the Eighteenth Century. *Clum or Reardon*
159. English and Irish Drama of the Nineteenth and Twentieth Centuries. *Clum and Reardon*
169. Modern European Drama. *Clum or Reardon*
179. American Drama. *Clum or Reardon*
- 181S. Conference on Drama. *Staff*

## French

110. French Comedy in the Seventeenth and Eighteenth Centuries. *Stewart*
111. French Drama of the Nineteenth Century. *Staff*
112. French Drama of the Twentieth Century. *Cordle or Staff*
151. Theory and Form of Tragedy. *Fowlie*
233. Contemporary French Theater. *Fowlie*

## German

- 115S. Drama (1770-1890). *Alt*

## Romance Languages

160. An Approach to Comedy. *Wardropper*

## Slavic Languages

105. The Russian Theater and Drama. *Jezierski*

## Economics

Professor Kelley, *Chairman*; Professor Davies, *Director of Undergraduate Studies*; Professors Blackburn, Bronfenbrenner, Goodwin, Kreps, Lewis, Naylor, Saville, Treml, Vernon, Wallace, and Yohe; Associate Professors de Marchi, Grabowski, Graham, Havrilesky, Tower, and Weintraub; Assistant Professors Bolnick, Cook, Lipscombe, McElroy, and Wyse

Economics courses aim to develop the critical and analytical skills essential for understanding economic problems and institutions, in both their contemporary and in their historical setting. Although no particular vocational or professional goal is emphasized, these courses provide the academic background necessary for positions in industry, for work in many branches of government service, for law school, and for graduate study in business administration, economics, and the social sciences.

Students planning to do graduate work in economics are advised to take as many of the following courses in mathematics (listed in preferential order) as their schedules permit: Mathematics 31, 32, 103, 104, 131, and 135, 136.

**1. National Income and Public Policy.** Basic economic analysis emphasizing current public policy issues. How the level and rate of growth of aggregate national income and output are determined. What causes unemployment, inflation, and international payment problems. How monetary policy (money supply and interest rates) and fiscal policy (government expenditures and taxes) affect these problems. (Open only to freshmen.) One course. *Staff*

**2. Competition, Monopoly, and Welfare.** A continuation of Economics 1. How the composition of the economy's output and distribution of its income (who is rich and who is poor) are determined in a market economy by supply and demand. How and why markets work or fail to work and the implications of

social policies. Role of government in a market economy: contemporary problems of the environment, topics such as environmental economics, monopoly, unionism, international trade. Comparison of a market economy with other systems of economic organization. Economic problems of developing countries. (Open only to freshmen.) One course. *Staff*

**51. National Income and Public Policy.** See Economics 1. (Open to all students.) One course. *Staff*

**52. Competition, Monopoly, and Welfare.** See Economics 2. (Open to all students, except those who have had Management Sciences 50.) One course. *Staff*

**51D, 52D.** The same courses as Economics 51, 52 except taught as lectures with discussion sections. Two courses. *Staff*

**53. Economics of Contemporary Issues.** Modern economic problems, such as environmental deterioration and urban decay. The market as one of the interrelated subsystems of the social system, from institutionalist, Marxist, and other perspectives in the social sciences. One course. *Havrilesky*

**105. Economics and Justice.** Welfare judgments and the normative background of positive economics. Foundations of distributive justice and social change. Prerequisites: Economics 52 and Mathematics 31. One course. *Weintraub*

**106. The Economics of Poverty.** Poverty in the United States: its definition, measurement, history, racial dimensions, and the present and proposed policies for its amelioration. Prerequisite: Economics 52. One course. *Kreps*

**107. Economics of the Environment.** Theory and practical analysis of the interdependence between environmental quality and consumption, production, public policy, and economic growth. One course. *Staff*

**108. Economics of War.** Conflict theory, causes and economic consequences of war, military manpower, military-industrial complex, disarmament and the economy. Prerequisite: Economics 52. One course. *Weintraub*

**114. Economic Geography of Africa.** A continental study of the natural environmental factors of Africa and the basic economic patterns of adjustments and adaptations on regional or national bases. One course. *Tuthill*

**115. Fundamentals of Geography.** A functional social studies approach to geographic factors and their interrelationships. One course. *Tuthill*

**116S. Economic Geography of Anglo-America.** Geographic and economic regions of the United States and Canada; their resource base and the major economic activities, their spatial distribution, and relative significance. One course. *Tuthill*

**120. Economic Geography of Asia.** Concepts of agricultural, manufacturing, and distributive location theory, resource evaluation, and regional planning in Asia. One course. *Tuthill*

**132. Development of the American Economy.** From first settlement to present: quantity of goods and quality of life; employment and leisure; domestic and foreign commerce; poverty and affluence; money and prices; slavery, agriculture, and ghettos; business and labor; and roles and policies of governments. One course. *Saville*

**134. Quantitative Analysis in Economics.** Partial derivatives. Lagrange multiplier methods, matrix theory, and difference and differential equations. Prerequisite: Mathematics 31. One course. *Staff*



**138. Economic Statistics.** Survey of principal concepts and methods of application to economics. (Not open to students who have had Mathematics 53 or 183, Management Sciences 110, Psychology 117.) One course. *McElroy, Vernon, Wallace, or Wyse*

**139. Introduction to Econometrics.** Data collection, estimation, and hypothesis testing. Use of econometric models for analysis and policy. Prerequisites: Mathematics 31 and 32, or equivalent, and Economics 138 or Management Sciences 110 or equivalent. One course. *McElroy, Vernon, Wallace, or Wyse*

**149. Microeconomic Theory.** Cost and supply considerations in price theory; the demand for factors of production. The allocation of resources is examined in the context of competitive and monopolistic market structures. (Not open to students who have had either Economics 161 or Public Policy Studies 110.) *Graham, McElroy, Treml, or Vernon*

**150. History of Economic Thought.** Includes approaches to economic problems from Aristotle to Samuelson, emphasizing certain models and doctrines—their origins, relevancy, and evolution. Readings from Mun, Quesnay, Adam Smith, Malthus, Ricardo, Marx, Pareto, and Keynes. One course. *Goodwin or de Marchi*

**153. Monetary Economics.** The evolution and operations of commercial and central banking and nonbanking financial institutions in the United States, the determination of monetary aggregates and interest rates, the financial impacts of Treasury operations, and the linkages from Federal Reserve actions to price level, employment, economic growth, and balance of payments objectives. One course. *Bolnick, Havrilesky, or Yohe*

**154. Aggregate Economics.** Concepts and measurement of national income and expenditures, employment, interest rates, and price levels; the theoretical determination of these aggregates; applications of macroeconomic theory to business cycles and economic growth. One course. *Bronfenbrenner, Havrilevsky, Tower, or Yohe*

**155. Labor and Manpower Problems.** Current issues of unemployment, wages, and incomes of nonworkers. Manpower policies and labor-force quality. Sex, age, and race differences in labor-force participation and in earnings. Prerequisite: Economics 52. One course. *Kreps*

**156. Labor Economics.** The supply of labor; human fertility; investment in persons; hours of work and labor force participation; mobility and migration. The derived demand for labor. Wage distribution and wage structure. Unions and government in relation to labor. Prerequisite: Economics 149. One course. *Lewis*

**184. Canada: Problems and Issues of an Advanced Industrial Society.\*** (Also listed as Interdisciplinary Course 184.) *Preston and Visiting Lecturers*

**189. Business and Government.** Public policies which most directly affect the operation of competition in the business world. The economic basis for an evaluation of antitrust policy, public utility regulation, and public enterprise. Prerequisite: Economics 149 or consent of the instructor. One course. *Grabowski or Vernon*

**191, 192. Independent Study.** Directed reading and research. Admission will be subject to approval of the individual instructor and the department. Two courses. *Staff*

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\*This course does not count toward the courses required for an economics major.

193, 194. **Independent Study.** Same as Economics 191, 192 but for seniors. Two courses. *Staff*

198S. **Topics in Market Organization.** Market structures, related economic and legal issues, and attempted policy solutions in the United States. Prerequisite: Economics 149. One course. *Grabowski or Vernon*

### Junior-Senior Seminars in Economics

201S.1. **Current Issues in Economics.** Economic analysis of various public issues and policies. Readings, reports, and discussion on the health care system, crime and punishment, pollution and the environment, the performing arts, welfare, the energy crisis, and other topics. One course. *Davies*

201S.2. **Mathematical Economics.** Selected mathematical tools from symbolic logic, naive set theory, linear algebra, calculus, analysis and elementary topology applied to the analysis of economic problems. Topics include consumer choice, production, general equilibrium, and growth. Prerequisites: two semesters of college calculus and Economics 149. One course. *Graham*

201S.3. **Economics of Higher Education.** An analysis of the demand for educated manpower, public and private costs and benefits, the role of private higher education, public policy in higher education, and other topics. One course. *Blackburn*

201S.4. **Conflict and Cooperation in Economics.** Elements of game theory. Both cooperative and non-cooperative games with particular reference to economic problems such as trading, general equilibrium theory, oligopoly, and monopoly. One course. *Weintraub*

201S.5. **Impact Analysis of Government Policies.** The impact of government policies on income and employment utilizing methodology of input-output analysis. Applied problems: impact on environment, conflicting national priorities, technological change, marketing projections, foreign trade, shifts in demand, disarmament. One course. *Trembl*

201S.6. **Current Problems in International Monetary Arrangements.** The breakdown of the international monetary system. Effects of alternative retaliatory schemes. Effects on the international transmission of business conditions of flexible exchange rates. Optimum stocks of international monetary reserves. Prerequisite: Economics 149 or 265. One course. *Töwer*

201S.7. **Economics of Discrimination.** Analysis of the extent and effects of racial, sex, and age discrimination in the labor force; wage differentials, age-earnings profiles, and returns to education. One course. *Kreps*

### For Seniors and Graduates

200. **Capitalism and Socialism.** Selected ideological classics of new and old right and left economics including both "counsels for perfection" (Utopias) and "precepts for action" in political economy. Prerequisite: Economics 149 or 154, or consent of instructor. One course. (3 graduate units.) *Bronfenbrenner*

204S. **Advanced Money and Banking.** Monetary theory and its statistical and institutional implementation. Particular attention is given to the development of aggregative theories of prices, interest rates, and production; the functioning of monetary policy within various theoretical frameworks; and appraisal of the recent use and the limitations of Federal Reserve policy. One course. (3 graduate units.) *Havrilesky or Yohe*

**211. Introduction to Mathematical Economics.** Applications of topics in calculus, differential equations, and linear algebra to the theory of the firm, capital theory, macroeconomics, cycles, growth, and linear economic models. Prerequisites: Economics 149 and 154 and Mathematics 31 and 32, or equivalent. One course. *Graham*

**212S. Economic Science and Economic Policy.** An historical examination of the impact of economics on public policy; special attention to agriculture, labor relations, the Council of Economic Advisers, and the experience of other countries. Prerequisite: Economics 150. One course. *Goodwin*

**214. Geonomics: Geography and Contemporary Economics of Africa.** Environmental factors in relationship to major economic activities, emphasizing the resource base, ecological adjustments, landscape morphology, and international interdependence. A series of national studies synthesized into a continental format. Prerequisite: consent of instructor. One course. *Tuthill*

**219. Economic Problems of Underdeveloped Areas.** Consideration and analysis of the economic related problems of underdeveloped countries. Some attention will be given to national and international programs designed to accelerate the solution of these problems. One course. *Bolnick, Kelley, Naylor, or Saville*

**231S. Economic Development of Europe.** Sequence of local, national, and international economic structures under situations of changing trade, industry, agriculture, population, investment, war conditions, public ownership, cartels, colonialism, and prices. One course. (3 graduate units.) *Saville*

**232. Economic History of Japan.** Japanese economic development, stressing the period since the end of isolation. Prerequisite: one semester of economic analysis or of Far Eastern history. (Also listed as History 260.) One course. (3 graduate units.) *Bronfenbrenner*

**\*233. State and Urban Finance.** Expenditures, taxation, and financial administration in state and local governments, with emphasis on current problems. Special attention will be given to research methods and materials, and to the financial relations between state and local governments. One course. (3 graduate units.) *Davies or Wyse*

**234. Urban Economics.** Economic factors which influence the internal development of metropolitan areas. Urban problems involving slums, ghettos, poverty, and transportation are analyzed from an economic point of view. Prerequisite: Economics 149 or consent of instructor. One course. *Staff*

**235. The Economics of Crime, Law Enforcement, and Justice.** An analysis of the social costs of law enforcement and crime, a theoretical and empirical study of criminal deterrence, the measurement and production of law enforcement outputs, and an economic analysis of the courts and correctional system. Prerequisite: Economics 149 or equivalent. One course. *Cook*

**237, 238. Statistical Methods.** A study of statistical methods appropriate for dealing with problems in business and social science. In addition to developing more thoroughly the subject considered in business statistics, the following methods will be considered: simple, multiple, partial, and curvilinear correlation; curve fitting; probability; sampling distributions; and statistical inference. Prerequisite: Economics 138 or consent of instructor. Two courses. (6 graduate units.) *Staff*

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\*Offered on demand.



**243. Econometrics I.** Economic theory, mathematics, statistical inference, and electronic computers applied to analysis of economic phenomena. Objective is to give empirical content to economic theory. Matrix algebra used to develop topics in inference, linear regression, and systems of simultaneous equations. Use is made of the electronic computer. One course. (3 graduate units.) *Naylor or Wallace*

**244. Computer Simulation Models of Economic Systems.** A course on the design of computer simulation experiments for economic systems. Topics include generation of stochastic variates, computer models of queuing and inventory systems, models of the firm and industry, models of the economy, simulation languages, and experimental design. (Also listed as Computer Science 244.) One course. (3 graduate units.) *Naylor*

**245. Econometrics II.** Advanced theory and applications: includes specification error, generalized least squares, lag structures, Bayesian decision-making, simultaneous equation methods, and forecasting. Emphasis on current applied literature. A Track 1, third-level course. Prerequisite: Economics 243. One course. (3 graduate units.) *McElroy or Wallace*

**257. Manpower and Human Resources.** Allocation of human resources; returns to investments in education and training; qualitative composition of the labor force. One course. *Kreps*

**262. Trade Unionism and Collective Bargaining.** An intensive survey of the trade union as an economic institution is followed by a study of the principles and problems of union-management relationship as found in collective bargaining. One course. (3 graduate units.) *Staff*

**265S. International Trade and Finance.** A study of fundamental principles of international economic relations. Subjects covered include the economic basis for international specialization and trade, and the economic gains from trade, the balance of international payments, problems of international finance, investments, and monetary problems. Prerequisite: Economics 149. One course. (3 graduate units.) *Bronfenbrenner or Tower*

**287. Public Finance.** Economic aspects of such problems as the growth of government, the proper role of the state, the centralization and decentralization of government, government bureaucracy, the impact of taxes and spending on the wealthy and the poor as well as other public policies and questions. One course. (3 graduate units.) *Davies*

**293. Soviet Economic History.** Establishment of foundations of a socialist economy: collectivization, industrialization, and search for economic efficiency. One course. (3 graduate units.) *Trembl*

**294S. Soviet Economic System.** Economic planning and administration in the Soviet Union and other socialist countries. International comparisons. Theoretical and applied problems of resource allocation, economic development, and optimal microdecision-making in a nonmarket economy. One course. (3 graduate units.) *Trembl*

## DEPARTMENTAL MAJOR

*Prerequisites.* Mathematics 31, Economics 1 or 51, Economics 2 or 52. (Management Sciences 50 will be accepted in lieu of Economics 2 or 52.)

*Major Requirements.* Any five additional courses in the department. Substitution of courses in other departments for similar courses in the Economics



Department will not be permitted. Prerequisites for admission to a junior-senior seminar are two of the following courses: Economics 138, 149, 154.

For graduation with distinction in economics, at least one junior-senior seminar course and a paper are required. See section on Honors for other requirements.

## Education

Professor Flowers, *Chairman*; Associate Professor Colver, *Director of Undergraduate Studies*; Professors Adams, Cartwright, Gehman, Githens, Hurlburt, Katzenmeyer, Petty, Shuman, and Weitz; Associate Professors Ballantyne, Carbone, Di Bona, Johnson, Martin, and Pittillo; Part-time Instructor Swain; Lecturer Leach

Students who expect to teach in the public schools should confer with education Department advisers prior to registration each semester. Students who intend to teach in elementary schools should consult with Professors Adams, Carbone, Davis, or Petty; those intending to teach in secondary schools should consult with Professors Cartwright, Githens, or Shuman.

Students who do not expect to teach but desire an understanding of the school as part of their liberal education are advised to elect such courses as Education 100 and 113 for their introductory work in the department and then to elect further work in accordance with their special interests.

**100. Social and Philosophical Foundations of Education.** Basic features and assumptions, viewpoints and issues of education in contemporary America. One course. *Carbone, Di Bona, or Martin*

**105. Elementary Education: Reading.** Must be taken concurrently with Education 106. Half course. *Adams*

**106. Elementary Education: Language Arts.** Must be taken concurrently with Education 105. Half course. *Adams*

**107. Elementary Education: Mathematics.** Half course. *Petty*

**108. Elementary Education: Science.** Half course. *Githens*

**113. History of American Education.** American education from colonial times to the present. Development of schools, their organizations, administration, curriculum, and methods in relation to the social forces which produced our particular type of civilization. One course. *Johnson*

**118. Educational Psychology.** Psychology of learning, individual and social development, and psychology of adjustment as related to problems of instruction and the process of education. Prerequisite: Psychology 102, 103, 104, or 105. One course. *Davis*

**151. Public School Music Education.** (Also listed as Music Education 151.) Half course.

**152. Public School Music Literature.** (Also listed as Music Education 152.) Half course.

**161. Integrated Art in the Public School.** Materials and methods in basic two-dimensional art media. Half course. *Stars*

**162. Plastic Art in the Public School.** Basic three-dimensional art; emphasis on ceramics. Half course. *Stars*

**168. Secondary Education: Teaching Reading.** Teaching reading in the

content areas; determining students' reading levels; locating, evaluating, and selecting instructional materials. One course. *Adams*

**173, 174. Tutorial Practicum in Reading.** Assessment of reading abilities and disabilities; instruction of individuals and small groups of elementary and/or secondary students enrolled in the Duke Reading Center. Prerequisite: Education 105, 106, or Education 236, and consent of instructor. Two courses. *Adams*

**191, 192. Independent Study.** Directed reading and research for juniors. Prerequisite: approval of the instructor and the Director of Undergraduate Studies. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research for seniors. Prerequisite: approval of the instructor and the Director of Undergraduate Studies. Two courses. *Staff*

**195S. Elementary Education: Principles.** The nature, subject matter, and organization of elementary education for instruction in the primary and intermediate grades. Must be accompanied by Education 196. Half course. *Petty*

**196. Elementary Education: Internship.** Full time for second half of semester. One and one half courses. *Petty*

### For Seniors and Graduates

**201. Mathematics Program in the Elementary School.** Objectives, curriculum, and instructional strategies. One course. (3 graduate units.) *Petty*

**202. Comparative and International Education: Industrialized Nations.** Structure and functioning of educational institutions in selected developed societies. Relevant social science theory and methods. One course. (3 graduate units.) *Di Bona*

**203. Seminar in Philosophical Analysis of Educational Concepts.** Selected writings of contemporary philosophers; emphasis on such educational concepts as teaching, learning, knowing, understanding, indoctrination, explanation, and education. One course. (3 graduate units.) *Carbone*

**204. Educational Organization.** Theory and research on the processes of exchange between educational organizations and their external environments; influence organizational structure, goals, and practices. Examining schools, colleges, and universities through a comparative approach with other forms of social organizations: hospitals, businesses, and prisons. One course. (3 graduate units.) *Martin*

**206. Studies in the History of Educational Philosophy.** The educational views of leading thinkers in the history of Western philosophy, including Plato, Augustine, Locke, Rousseau, Kant, Whitehead, and Dewey. One course. (3 graduate units.) *Carbone*

**207. Social History of Twentieth Century American Education.** Twentieth century American education in context of social and intellectual history. One course. (3 graduate units.) *Johnson*

**209S. John Dewey.** Dewey's major writings with emphasis on his philosophy of education. One course. (3 graduate units.) *Carbone*

**210. The Politics of Education.** (Also listed as Political Science 210.) One course. (3 graduate units.) *Leach*

**213. Elementary School Organization and Administration.** Nursery school,

kindergarten, and the elementary school. Problems of internal organization and management of elementary school and its integration with secondary school. One course. (3 graduate units.) *Flowers, Petty, or Pittillo*

**215S. Secondary Education: Principles.** Principles, curriculum, and methods in secondary education. Prerequisite: C average overall and in teaching field or fields. Must be accompanied by Education 216. One course. (3 graduate units.) *Cartwright, Githens, or Shuman*

**216. Secondary Education: Internship.** Supervised internship in junior and senior high schools. Full time for half a semester. One and one half courses. (6 graduate units.) *Cartwright, Githens, or Shuman*

**217. The Psychological Principles of Education.** Advanced study of teaching, learning, and the learner. One course. (3 graduate units.) *Davis, Gehman, or Weitz*

**218. Comparative and International Education: Developing Societies.** One course. (3 graduate units.) *Di Bona*

**219. Comparative and International Education: South Asia.** Traditional and modern educational developments in India and Pakistan. One course. (3 graduate units.) *Di Bona*

**221. Programs in Early Childhood Education.** Objectives and philosophy underlying programs in early childhood education. One course. (3 graduate units.) *Staff*

**222. New Developments in Elementary School Curriculum.** One course. (3 graduate units.) *Staff*

**223. Teaching the Language Arts.** Comparison of current methods and materials in the teaching of handwriting, spelling, and oral and written composition. Analysis and correction of basic difficulties. One course. (3 graduate units.) *Adams*

**224. Teaching the Social Studies in Elementary Schools.** One course. (3 graduate units.)

**225. The Teaching of History and the Social Studies.** Evaluation of the objectives, content, materials, and methods in the teaching of history and the social studies. One course. (3 graduate units.) *Cartwright*

**226. Teaching Developmental and Remedial Reading in the Elementary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course. (3 graduate units.) *Adams*

**227. The Teaching of Geography.** One course. (3 graduate units.)

**229. Assessments of Reading Disability Cases.** Standardized tests, other methods, and informal procedures used in diagnosing reading problems of elementary and secondary pupils. One course. (3 graduate units.) *Adams*

**232. Psycho-educational Counseling with Parents.** Individual and group counseling concerning psycho-educational problems of parents and children. Prerequisite: consent of instructor. One course. (3 graduate units.) *Ballantyne, Davis, or S. Gehman*

**233. Improvement of Instruction in English.** Recent developments and research techniques in the teaching of English through individual projects. Prerequisite: consent of instructor. One course. (3 graduate units.) *Shuman*

**234. Secondary School Organization and Administration.** Objectives and

philosophy underlying the organization and administration of the secondary school. One course. (3 graduate units.) *Flowers*

**236. Teaching Developmental and Remedial Reading in the Secondary School.** Principles, methods, and materials for the development of effective reading attitudes and skills in developmental and remedial programs. One course. (3 graduate units.) *Adams*

**237. Teaching of Literature in Secondary Schools.** Conventional, adult, and transitional literature is considered. One course. (3 graduate units.) *Shuman*

**238. Content, Supervision, and Administration of Reading Programs.** Objectives, organization, attributes, and evaluation of reading programs. One course. (3 graduate units.) *Adams*

**239. Teaching of Grammar, Composition, Mechanics, and Usage in Secondary School.** Recent developments. One course. (3 graduate units.) *Shuman*

**240. Career Development.** Analysis of the world of work; socio-personal factors affecting occupational choice; theories of career developments; use of occupational and educational resources. One course. (3 graduate units.) *Ballantyne*

**241. Foundations of Counseling and Personnel Services.** Scope, principles, historical background, services, trends, and issues of counseling, and pupil personnel services. One course. (3 graduate units.) *Ballantyne or Colver*

**243. Personality Dynamics.** Personality structure and dynamics emphasizing implications for counseling and instruction. Prerequisite: six units of psychology or educational psychology. One course. (3 graduate units.) *S. Gehman*

**244. Counseling Techniques.** Individual counseling techniques; diagnosis, interviewing, program planning and counseling evaluation. Prerequisites: Education 243 and 258 or equivalent, which may be taken concurrently. One course. (3 graduate units.) *S. Gehman*

**245. Theories of Counseling.** One course. (3 graduate units.) *Weitz*

**246. Teaching of Mathematics.** Aims, curriculum, and classroom procedure for teaching secondary school mathematics. One course. (3 graduate units.)

**247. Practicum in Guidance and Counseling.** Local field experience in counseling and guidance program. Minimum of 150 hours of case work and supervision. Prerequisites: Education 244 and consent of instructor. One course. (3 graduate units per semester.) (May be repeated.) *Ballantyne, Colver, Gehman, or Weitz*

**248. Practicum in Counseling.** Individual counseling; test administration, intake interviewing, diagnosis, program planning, report preparation and evaluation. Minimum of 150 hours of case work and conferences with the supervisor. Prerequisite: consent of instructor. One course. (3 graduate units per semester.) (May be repeated.) *Ballantyne, Gehman, or Weitz*

**249. Exceptional Children.** Survey of major categories of exceptional children: mentally retarded, emotionally disturbed, brain injured, learning disabled, physically handicapped, visual and auditory deficient, culturally deprived, and gifted. Etiology (biological and environmental factors), diagnosis, and treatment. One course. (3 graduate units.) *Davis*

**250, 251. Teaching Emotionally Disturbed Children: Internship.** Basic principles and practices in teaching and organization of instructional materials. Work with children under supervision of a certified teacher of emotionally dis-



turbed children. Experience in general classroom, small group, and individualized instruction. Participation in staff conferences with psychiatrists, psychologists, social case workers, and professional educators. Two courses. (3 graduate units per semester.) *S. Gehman*

**253. Introduction to Law and Education.** Basic elements of legal research, with primary emphasis on concepts and procedures relevant to educational problems. Analysis of selected cases. One course. (3 graduate units.) *Martin*

**254. Law and Higher Education.** Concepts and procedures relating to higher education. Emphasis upon court decisions. Prerequisite: Education 253 or consent of instructor. One course. (3 graduate units.) *Flowers*

**255. Assessment of Abilities.** The selection, use, and interpretation of various instruments for predicting and evaluating the outcome of educational experiences including surveys of standardized tests of aptitude and achievement. One course. (3 graduate units.) *Colver*

**256. Classroom Assessment of Student Achievement.** The techniques used by classroom teachers to evaluate student progress. Special emphasis will be directed to tests written by teachers. One course. (3 graduate units.) *Colver*

**258. Assessment of Personality, Interests, and Attitudes.** Rationale, construction, use, and interpretation of standardized instruments designed for the assessment of students' interests, attitudes, and personalities. Emphasis on counseling applications. Prerequisites: Education 243 and 255 or consent of instructor. One course. (3 graduate units.) *Colver or Weitz*

**259. Problems in Law and Education.** Current issues; researching of cases, constitutional decisions, and statutes. Prerequisite: Education 253 or consent of instructor. One course. (3 graduate units.) *Flowers, Martin, or Pittillo*

**260. Educational Research I.** Research design, univariate quantitative methods, and applications of the computer to research problems. One course. (3 graduate units.) *Katzenmeyer*

**261. Educational Research II.** Analysis of covariance and multiple regression, discriminant function analysis, computer applications in research. Prerequisite: Education 260 or its equivalent. One course. (3 graduate units.) *Katzenmeyer*

**262. Educational Research III.** Multivariate analysis of variance, factor analysis, cluster analysis, and path analysis. Education 262 is offered only in a block with Education 261. One course. (3 graduate units.) *Katzenmeyer*

**266. Basic Science for Teachers.** Natural and physical science through selected readings, the use of experiments and demonstrations, construction and use of equipment, and field studies. One course. (3 graduate units.) *Githens*

**268. Seminar in Contemporary Educational Criticism.** One course. (3 graduate units.) *Carbone, Di Bona, Johnson, or Martin*

**270. Junior and Community College.** History, philosophy, and roles. Introductory course for future teachers, counselors, or administrators in a two-year college. One course. (3 graduate units.) *Hopkins or Hurlburt*

**271. Teaching in the Junior and Community Colleges.** Special attention to alternative systems, and the individualization of instruction for a heterogeneous student population. One course. (3 graduate units.) *Hopkins*

**272. Teaching Communication Skills in Early Childhood Education.** From

birth to age eight with emphasis on reading readiness and language growth. One course. (3 graduate units.) *Adams*

**273, 274. Clinical Reading Practicum.** Experiences in the diagnosis and correction of reading disabilities in elementary and secondary students. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Adams*

**276. The Teaching of High School Science.** Discussion, lectures, and collateral reading related to such topics as aims, tests, curriculum, classroom and laboratory procedure, field trips, and course and lesson planning for secondary-school science. One course. (3 graduate units.) *Githens*

**285. Audiovisual Aids in Education.** Aims and psychological bases of audiovisual materials in the classroom. Offered in summer only. One course. (3 graduate units.) *Staff*

**291. Public and Community Relations of Schools.** One course. (3 graduate units.) *Hurlburt*

## DEPARTMENTAL MAJOR

Majors in education are offered in elementary school education and science education. The department offers work leading to graduation with distinction. See the section on Honors in this *Bulletin*.

Duke University is accredited by the National Council for Accreditation of Teacher Education for the preparation of elementary and secondary school teachers. The programs are also approved by the North Carolina Department of Public Education.

The program for students who intend to teach is designed to prepare for positions in either elementary or secondary schools. Prerequisites for all prospective teachers are Psychology 102, 103, 104, or 105, preferably during the sophomore year; and Education 100 or 113, preferably during the junior year. Only students with a C average or higher overall and in the major or teaching fields will be admitted to student teaching. Special methods courses should be taken prior to undergraduate student teaching, which is part of a planned professional semester in the senior year.

**Elementary Education.** A major in this program is designed for those students who desire to meet the certification requirements for teaching in the elementary school.

### Required General Courses

English	1 course or by examination
Foreign language	Second year (or equivalent) or 2 courses in fine or practical arts
Biological Science	2 courses
Mathematics	1 course
History 91, 92	2 courses
Political Science 91	1 course
Economics 115 or 120	1 course
Literature	1 course
Psychology 102, 103, 104, or 105	1 course

### Required Specialized Subject Matter Courses

Physical Education (for Early Childhood or Intermediate Grades)	½ course
Health Education 134	½ course
Music Education 151, 152	1 course
Education 161, 162	1 course
Education 105	½ course
Education 106	½ course

Education 107	1/2 course
Education 108	1/2 course

#### Required Professional Courses

Education 100 or 113	1 course
Education 118	1 course
Education 195S	1/2 course
Education 196	1 1/2 courses

A major in elementary education must include the concentration of at least six courses in subjects commonly taught in elementary school, chosen from one of the divisions—humanities, natural science, or social science. The concentration may include courses from the general education requirement.

**Secondary School Teaching.** Whatever their majors, students preparing to teach must consult the appropriate adviser in the Education Department prior to each registration period to assure that they will be eligible to enter the required student teaching program. Students preparing to teach in a secondary school meet certification requirements by qualifying in one teaching field. Prospective secondary school teachers must major in a subject other than education. Qualifications for certification to teach a single science may be sought under either the A.B. or the B.S. degree. Students desiring to major in science education should read the description of that program given below.

**Science Education.** Students intending to teach sciences in secondary schools may major in science education. The program meets certification requirements and provides a broad background in several sciences. Early consultation with advisers in the Education Department and a selected department in science or mathematics is required. Five courses in education (100 or 113, 118, 215S, 216, 246, or 276) are required. The science education program provides the required two courses in mathematics and laboratory work in at least three sciences, with concentration in one of these. University curriculum requirements account for a maximum of fourteen courses. The remaining eighteen are selected to provide breadth in at least three sciences and must include a minimum of four advanced courses. The general and professional courses required for certification may be met in part both by the University curriculum distribution and within the eighteen courses devoted to concentration.

A major in science education leads to an A.B. degree with the normal thirty-two course limit. Students wishing to have the B.S. degree may expect to take more than thirty-two courses. The normal number of courses may be reduced by advanced placement or proficiency tests in English and foreign languages.

**Materials and Methods Courses.** Certain courses with materials and methods in teaching various subjects in the public school curriculum are listed in the proper subject matter department. These courses are intended to give credit for teaching certificates and are recommended by the Education Department for such credit.

## STUDENT TEACHING

During the eight weeks of student teaching, students may be required to live in a community which is some distance from Durham. This will entail additional living expenses to be borne by the student teacher. Room rent is not refunded.

## English

Professor Budd, *Chairman*; Associate Professor Butters, *Director of Undergraduate*

*Studies*; Associate Professor Gerber, *Supervisor of Freshman Instruction*; Professors Anderson, Cady, Duffey, Ferguson, Nygard, Price, Randall, Reiss, Ryals, Smith, Turner, and Williams; Associate Professors Applewhite, DeNeef, Harwell, Jackson, Jones, Mellown, Michalak, Monsman, Reardon, Strandberg, and Wetherby; Assistant Professor Clum; Part-time Visiting Associate Professor Armitage

## WRITING AND LANGUAGE

**1. Freshman Composition.** Weekly expository themes based on British and American prose fiction and non-fiction; one general lecture, one section meeting, and one individual conference each week. One section of this course is reserved for students interested in creative writing. One course. *Staff*

**10. Introductory Composition and Literature.** A skills course in composition and literature (contemporary essays and short stories), with frequent writing assignments: five meetings each week and regular individual conferences. (This course, offered in the summer transitional program, does not satisfy the English composition proficiency requirement.) One course. *Staff*

**59. Film Criticism.** Introduction to principles of writing about the cinema. One course. *Clum, Jones, Monsman, or Strandberg*

**65S, 66S. Imaginative Writing.** Informal essay, short story, poetry, drama, and film. Prerequisite: consent of instructor. Two courses. *Monsman*

**101S. Advanced Expository Writing.** Techniques of effective writing. One course. *Butters, Ferguson, or Harwell*

**103S, 104S. Creative Writing.** Class discussion of students' manuscripts and individual conferences with the instructor. Open to sophomores, juniors, and seniors. Students desiring admission to either course should present a piece of writing to the instructor as early as possible during the preceding semester. Two courses. *Applewhite, Monsman, or Price*

**105S. The Composition of Prose Narrative.** The writing of a novel or novella or a group of short stories. Primarily for juniors and seniors; consent of instructor required early in the preceding semester. One course. *Price*

**106S. The Writing of Poetry.** A study of meter, image, tone, and dramatic organization in traditional and modern poems as a basis for original composition. Prerequisite: consent of instructor. One course. *Applewhite*

**107. Introduction to Linguistics.** Origin and nature of language; methods of descriptive linguistics with reference to historical and comparative linguistics. (Also listed as Anthropology 107.) One course. *Staff*

**108. Development of the English Language.** An elementary historical study of the English language: patterns of change and growth, with some attention to methods of philological inquiry and the relations of philology to literary studies. One course. *Butters*

**109. Modern English Grammar.** A descriptive study of written and spoken American English of the present time, with attention to standards of usage and pronunciation, and the relations of grammar to composition. One course. *Butters*

## ENGLISH AND AMERICAN LITERATURE

**Introduction to Literature.** One course each; English 26 may be taken twice.



20. (This number represents one course credit for advanced placement.)

21S. Studies in the Novel.

22S. Studies in Drama.

23S. Studies in the Short Story.

24S. Studies in Poetry.

25S. Studies in the Epic.

26. Studies in Special Topics. (Some sections are taught as seminars; see the Schedule of Courses.)

55, 56. **Representative British Writers.** Usually these works are studied in the first semester: Chaucer's Prologue to *The Canterbury Tales* and at least two tales, Shakespeare's *Henry IV*, *Hamlet*, or *King Lear*, and one other play, John Donne's poetry (selections), Milton's *Paradise Lost* (selections), and some of the shorter poems; in the second semester: novels by Fielding (*Joseph Andrews*) and Dickens (*Great Expectations*), and selections from the poetry of Pope, Wordsworth, Keats, and Yeats. Two courses. *Staff*

57, 58. **Representative American Writers.** Selections and complete works. First semester: Poe, Emerson or Thoreau, Hawthorne, Melville, Whitman, Dickinson, and Twain. Second semester: James, Frost or Robinson, Crane or Dreiser, O'Neill, Faulkner, Hemingway, and others. Prospective majors should take courses numbered 161-162, 171-172, instead of these courses. Two courses. *Staff*

112. **English Literature of the Middle Ages.** A study of the principal forms and emphasis of English prose, poetry, and drama of the Anglo-Saxon and Middle English periods (excluding Chaucer), read in translation. (Also listed as Comparative Literature 112.) One course. *Reiss*

113. **Chaucer.** *The Canterbury Tales* and the minor poems, with attention to their literary and social background. One course. *DeNeef, Nygard, or Reiss*

121. **English Literature of the Sixteenth Century.** Emphasis in poetry on Wyatt, Sidney, Spenser, Raleigh, Shakespeare; in prose on Sidney and Florio's *Montaigne*; in drama on Marlowe. One course. *DeNeef*

123, 124. **Shakespeare.** First semester: twelve plays before 1600. Second semester: about ten plays after 1600. Two courses. *DeNeef, Jones, or Williams*

125, 126. **English Literature of the Seventeenth Century.** First semester: emphasis in poetry on Jonson and the cavaliers, Donne and the metaphysicals; in drama on Jonson, Tourneur, Webster, Ford; in prose on character writers, Bacon, Burton, Donne, Browne. Second semester: emphasis in poetry on later metaphysicals, Cowley, Denham, Waller, Dryden; in prose on Taylor, Dryden, Hobbes, Locke; in drama on Dryden, Congreve, Etherege, Wycherly. Two courses. *DeNeef or Randall*

127. **Milton.** Milton's poetry and prose, their relation to the period and to other great works of literature. One course. *DeNeef or Price*

129. **English Drama from the Middle Ages through the Eighteenth Century.** Emphasis on Tudor and Stuart drama, exclusive of Shakespeare. One course. *Clum or Reardon*

131, 132. **Eighteenth Century Literature.** First semester: Pope, Swift, Defoe, Addison, Steele, and Fielding. Second semester: Johnson, Gray, Boswell, Goldsmith, Sheridan, Blake, and later novelists. Two courses. *Ferguson or Jackson*

**133. Studies in a Major British Author.** Readings in the works of such pre-1800 writers as Dryden, Fielding, Pope, or Johnson. One course. *Staff*

**138. The English Novel from the Beginnings to 1800.** Some of the writers studied are Nashe, Deloney, Lyly, Sidney, Bunyan, Behn, Defoe, Richardson, Fielding, Smollett, and Sterne. One course. *Jackson or Randall*

**141, 142. English Literature of the Early Nineteenth Century.** The course begins with the forerunners of Romanticism. The chief emphasis in the first semester is on the work of the older Romantics: Wordsworth, Coleridge, Lamb, and Hazlitt. In the second semester the chief emphasis is on the work of the younger Romantics: Byron, Shelley, Keats, and DeQuincey. Two courses. *Applewhite*

**143. Studies in a Major British Author.** Readings in the works of such post-1800 writers as Coleridge, Eliot, Wordsworth, or Yeats. One course. *Staff*

**145, 146. English Literature, 1832-1900.** A study of the major writers of poetry and prose from Macaulay to Hardy. First semester: Macaulay, Tennyson, Carlyle, the Brownings, Newman, Mill, Clough, and FitzGerald. Second semester: Arnold, the Rossettis, Ruskin, Patmore, Meredith, Huxley, Morris, Swinburne, Pater, and Hardy. Collateral reading from novels of the period. Two courses. *Harwell, Monsman, or Ryals*

**148. The English Novel in the Nineteenth Century.** Some of the writers studied are Scott, Austen, Dickens, Thackeray, Trollope, the Brontës, George Eliot, Meredith, Butler, and Hardy. One course. *Harwell or Monsman*

**151, 152. English Literature of the Twentieth Century.** Emphasis on principal writers of fiction, drama, and poetry. First semester: usually Conrad, Shaw, Yeats, Wells, Synge, Forster, Woolf, and Joyce. Second semester: usually Lawrence, Cary, Huxley, Auden, Greene, Beckett, and Dylan Thomas. Two courses. *Mellown or Smith*

**153, 154. Twentieth Century Poetry.** A study of twentieth century poetry and criticism of poetry in England and America. Problems in critical analysis and interpretation. First semester: the emphasis is on sources in nineteenth century symbolism and on the poetry of Hopkins, Yeats, Eliot, Pound, and Stevens. Second semester: the emphasis is on the poets and the poetic theories of the last thirty years. Two courses. *Mellown or Smith*

**158. The English Novel in the Twentieth Century.** Some of the writers studied are Conrad, Lawrence, Forster, Joyce, Woolf, Huxley, Cary, Amis, and Golding. One course. *Mellown or Smith*

**159. English and Irish Drama of the Nineteenth and Twentieth Centuries.** Emphasis on the modern period. One course. *Clum or Reardon*

**161. American Literature to 1800.** Colonial authors, Bradford, Taylor, Cotton Mather, Edwards, Byrd, and Franklin, and authors of the early Republic such as Tyler, Freneau, and C.B. Brown. One course. *Staff*

**162. American Literature, 1800 to 1860.** Prose and poetry of American Romanticism: Emerson, Thoreau, Hawthorne, Poe, Melville, and Whitman. (Not open to students who have taken English 57.) One course. *Staff*

**163. Studies in a Major American Author.** Readings in the works of such writers as Faulkner, Hawthorne, James, or Whitman. One course. *Staff*

**171. American Literature, 1860 to 1915.** Dickinson, Twain, James, the social

and philosophical essayists, Crane, Dreiser, Robinson, and Frost. (Not open to students who have taken English 58.) One course. *Staff*

**172. American Literature, 1915-1960.** Eliot, Fitzgerald, Hemingway, Faulkner, and their contemporaries. One course. *Staff*

**175. Contemporary American Writers.** Novelists and poets prominent in the recent past. One course. *Staff*

**177, 178. American Fiction.** A survey of the novel and the short story. First semester: nineteenth century from Washington Irving to Stephen Crane. Second semester: twentieth century through ten representative books. Two courses. *Anderson, Budd, or Clum*

**179. American Drama.** Representative plays from Colonial times to the present: a historical survey. One course. *Clum or Reardon*

**Conference Courses.** Seminars primarily for majors, with priority given to seniors. Emphasis on literary theory and critical writing with intensive study of one or more authors. One course each; each course may be taken twice.

**180S. Conference on Criticism.**

**181S. Conference on Drama.**

**182S. Conference on Poetry.**

**183S. Conference on Fiction.**

**184S. Conference on Prose Non-Fiction or a Special Topic.**

**188. The Origins and Aims of Narrative.** Readings in ancient, middle, and modern narrative literature—epic, tale, drama, novel—with attention to the origins of the narrative impulse, its evolution from sacred to secular, its deducible purposes, and its present manifestations. One course. *Price*

**191, 192, 193, 194. Independent Study.** Directed reading and research. Students should consult the Director of Undergraduate Studies as early as possible in the semester preceding enrollment. One course each. *Staff*

**195T. Tutorial.** Directed reading and research. Prerequisite: consent of the Director of Undergraduate Studies in the preceding semester. One course. *Staff*

**197T, 198T. Distinction in English.** Tutorials in the reading and criticism of selected British and American writers. Three essays the first term; three essays or an extended paper the second term. Upon recommendation of the tutors and completion of other requirements, the student may graduate with distinction in English. Admission by invitation of the department; students expecting to graduate early may take these courses in reverse sequence, beginning in the spring term preceding their graduation. Two courses. *Jones*

## FOREIGN LITERATURE (IN TRANSLATION)

**165. Readings in Scandinavian Literature.** A study of selections in translation from Ibsen, Strindberg, Lagerkvist, and others; their place in the literary tradition of Scandinavia and their relationships with English and American Literature. (Also listed as Comparative Literature 165.) One course. *Anderson*

**166. The Bible as Literature.** Detailed study of selected books of Old and New Testament and *Apocrypha*, emphasizing their literary form and artistry and their various expressions in world literature. Course will also include a history of the Bible in English. One course. *Staff*

**167. Canadian Literature in English.** Survey of nineteenth century writers. Emphasis on twentieth century poets and novelists such as E. J. Pratt, F. R. Scott,

A.J.M. Smith, Earle Birney, Sinclair Ross, Hugh MacLennan, Irving Layton, Leonard Cohen, and Margaret Atwood. One course. *Armitage*

**168. Readings in European Literature.** Works of European literature related to similar works in English: Montaigne, Rabelais, Cervantes, Voltaire, Dostoevsky, and others. One course. *Harwell*

**169. Modern European Drama.** Ibsen to the present; the free theater movement and the drama of ideas. (Also listed as Comparative Literature 169.) One course. *Clum or Reardon*

## **SPEECH AND THEATER**

**50. Essentials of Public Speaking.** A basic course in public speaking, designed to give the student the poise and confidence necessary to think and speak freely before an audience. Particular attention is paid to the gathering and organization of speech materials and to oral presentation. Not open ordinarily to juniors and seniors. One course. *Michalak*

**100. English for Foreign Students.** A non-credit course which includes an individual tutorial stressing writing and a small class emphasizing conversation and pronunciation. The tutorial is restricted to registered undergraduate and graduate foreign students. *Staff*

**110. Essentials of Public Speaking.** A basic course in public speaking for juniors and seniors dealing with the same matters as English 50. (Not open for credit to students who have taken English 50.) One course. *Michalak*

**119. History of the Theater.** The origin and development of drama, acting, and stagecraft from ancient Greece to the modern European and American theater. Production problems of representative plays of the various periods will be discussed. Primarily for juniors and seniors; open also to sophomores with consent of instructor. One course. *Michalak or Clum*

**120. The Speaking Voice.** A study of the mechanisms of speech. Emphasis is placed on providing the skills necessary for the improvement of voice, pronunciation, and diction. Methods of correcting minor functional speech disorders will also be studied. One course. *Wetherby*

**130. Play Production.** An introduction to the methods of producing a play— theater organization, play selection, casting, and rehearsal. Lectures and laboratory. Primarily for juniors and seniors; open also to sophomores approved by the instructor. One course. *Michalak*

**140S. Argumentation.** The principles of argumentation and debating. The techniques of analysis, investigation, evidence, reasoning, brief making, and refutation. Participation in class discussion and debates. Prerequisite: consent of instructor. One course. *Wetherby*

**150. Persuasive Speaking.** The psychological and sociological techniques used in gaining acceptance of ideas through speech. Study is made of the factors influencing human behavior; audience analysis and motivation; choice, arrangement, and adaptation of material. Extensive practice in persuasive speaking. One course. *Wetherby*

**160, 170. Broadcasting.** A study of the background of radio and television broadcasting. First semester: the development of broadcasting as an industry and as a literary form. Second semester: legal and social aspects, and various program forms. Two courses. *Wetherby*



## FOR SENIORS AND GRADUATES

**207. Old English Grammar and Readings.** One course (3 graduate units.)  
*Nygard or Reiss*

**208. History of the English Language.** Introductory survey of the changes in sounds, forms, and vocabulary of the English language from its beginning to the present, with emphasis on the evolution of the language as a medium of literary expression. One course. (3 graduate units.) *Nygard or Reiss*

**209. Present-Day English.** A description of present-day American English from the point of view of modern linguistic theory; comparison of traditional and structural grammars; semantic change; the relation of the written to the spoken language; usage. One course. (3 graduate units.) *Butters, Nygard, or Reiss*

**210. Old English Literary Tradition.** Prerequisite: English 207. One course. (3 graduate units.) *Nygard or Reiss*

**212. Middle English Literary Tradition.** From 1100 to 1500 (excluding Chaucer); medieval genres; reading of selected texts. A reading knowledge of Middle English is recommended. One course. (3 graduate units.) *Nygard or Reiss*

**215. Chaucer. *The Canterbury Tales*.** One course. (3 graduate units.) *Nygard or Reiss*

**216. Chaucer. *Troilus and Criseyde* and the minor poems.** One course. (3 graduate units.) *Nygard or Reiss*

**221. English Prose of the Sixteenth Century.** Readings in the major forms and authors. One course. (3 graduate units.)

**222. English Non-Dramatic Poetry of the Sixteenth Century.** Extensive select readings from representative types and authors, excluding Spenser. One course. (3 graduate units.) *DeNeef*

**223. Spenser.** One course. (3 graduate units.) *DeNeef*

**224. Shakespeare.** The plays. One course. (3 graduate units.) *Williams*

**225, 226. Tudor and Stuart Drama, 1500-1642.** First semester: Peele, Lyly, Greene, Kyd, Dekker, Heywood, Chapman, and Marston, with emphasis on Marlowe. Second semester: Jonson, Webster, Beaumont, Fletcher, Massinger, Middleton, Ford, and Shirley. Two courses. (6 graduate units.) *Randall*

**229, 230. English Literature of the Seventeenth Century.** Major works in prose and poetry from 1600 to the death of Dryden. Two courses. (6 graduate units.) *DeNeef, Jackson, Randall, or Williams*

**232. Milton.** Milton's poetry and prose, with emphasis on the major poems. One course. (3 graduate units.)

**234. English Drama, 1642-1800.** The heroic play and comedy of manners of the Restoration; the important plays, serious and comic, of the eighteenth century. One course. (3 graduate units.) *Jackson*

**235, 236. The Eighteenth Century.** First semester: Swift, Pope, Defoe, Addison, Steele, and others. Second semester: Gray, Johnson, Boswell, Collins, Goldsmith, the novelists, and other writers. Two courses. (6 graduate units.) *Ferguson or Jackson*

**241, 242. English Literature of the Early Nineteenth Century.** First semester: poets and prose writers, 1790-1810, with emphasis on Wordsworth and Coleridge. Second semester: 1810-1830, with emphasis on Byron, Shelley, and Keats. Two courses. (6 graduate units.) *Monsman*

**245, 246. English Literature of the Later Nineteenth Century.** First semester: Carlyle, Dickens, Thackeray, Tennyson, and Browning. Second semester: Arnold, Ruskin, Pater, George Eliot, Meredith, the Pre-Raphaelites, and Swinburne. Two courses. (6 graduate units.) *Monsman or Ryals*

**251, 252. English Literature of the Twentieth Century.** Representative work of leading writers from 1900 to 1950, in fiction, drama, and poetry. First semester: Shaw, Conrad, Yeats, Wells, Bennett, Galsworthy, Ford, Synge, Forster, and Lawrence. Second semester: Joyce, Woolf, Edith Sitwell, Eliot, Huxley, Graves, Bowen, Auden, and Dylan Thomas. Critical analysis of selected texts, with discussion of techniques and ideas. Two courses. (6 graduate units.) *Mellown or Smith*

**263, 264. American Literature, 1800-1865.** Emphasized in the first semester are Emerson, Thoreau, and Hawthorne; in the second semester, Poe and Melville. Two courses. (6 graduate units.) *Anderson, Jones, or Turner*

**267, 268. American Literature, 1865-1915.** Selected works of representative authors. First semester: Whitman, Mark Twain, James, Howells, Dickinson, and the Local Colorists. Second semester: Crane, Norris, Dreiser, Cather or Wharton, O'Neill, Robinson, and Frost. Two courses. (6 graduate units.) *Budd or Cady*

**270, 271. Southern Literature.** Emphasis in the first semester is on Byrd, Kennedy, Simms, Poe, Timrod, and the humorists; in the second, on Lanier, Harris, Cable, Twain, Glasgow, and Faulkner. Two courses. (6 graduate units.) *Turner*

**275, 276. American Literature since 1915.** First semester: selected fiction from Gertrude Stein to the present. Second semester: poetry from the Imagist movement to the present. Two courses. (6 graduate units.) *Duffey or Strandberg*

**280. Introduction to Folklore.** A survey of the materials of popular tradition, the folksong, the folktale, the proverb, the riddle, and other forms; the methods of folklore investigation; and the relation of these popular genres to literary tradition. One course. (3 graduate units.) *Nygard*

**285. Literary Criticism.** Readings from the major critics, Plato to the eighteenth century with emphasis on formative ideas and historical continuity. One course. (3 graduate units.) *Jackson*

**287. Recent Critical Thought.** Questions of the nature and value of literature as reflected in recent criticism, theoretical and practical. One course. (3 graduate units.) *Duffey*

**289. Literary Biography.** One course. (3 graduate units.)

## DEPARTMENTAL MAJOR

*Basic Requirement.* English 55-56.

*Major Requirements.* Seven courses at the 100 level or above: one course in a major author; three courses in period surveys, one in each division—(a) British Literature, before 1800, (b) British Literature, after 1800, (c) American Literature; and three additional courses.

In choosing the three additional courses, the student should carefully consider with the adviser the opportunities available in the departmental offerings for concentration in English or American literature; in poetry, fiction, or dramatic literature; in historical periods; in critical theory, linguistics, or creative writing; or in speech and theater.

The English Department recommends that its majors complete at least two years of college-level study, or the equivalent, of a foreign language. Those majors contemplating graduate work in English should note that many M.A.

programs require examination in one foreign language and that Ph.D. programs commonly require examination in two.

*Honors.* The department offers work leading to graduation with distinction. For further information consult the Director of Undergraduate Studies and the section on Honors in this *Bulletin*.

## Forestry and Environmental Studies

Students in arts and sciences who are preparing for professional careers in forest resource sciences or administration should refer to the section on Professional Combination Programs in this *Bulletin*. The courses listed below are open to undergraduate students in arts and sciences by consent of the instructor. The courses are described in the *Bulletin of the School of Forestry and Environmental Studies*.

### FORESTRY

**152. Conserving Natural Resources.** One course. *Staff*

**203. General Meteorology.** Prerequisites: introductory courses in calculus and physics. One course. *Vukovich*

**204. Microclimatology.** Prerequisites: introductory courses in calculus and physics. One course. *Knoerr*

**205. Tree Growth and Development.** Prerequisites: introductory courses in botany and chemistry. One course. *Barnes*

**206. Anatomy of Woody Plants.** Prerequisite: Forestry 241 or plant anatomy. (Also listed as Botany 206.) One course. *Philpott*

**215. Air Pollution Meteorology.** Prerequisite: Forestry 203 or equivalent. (Course sponsored by Triangle Universities Consortium on Air Pollution and taught by faculty. One course.

**217L. Environmental Instrumentation.** (Also listed as Botany 217L.) One course. *Knoerr*

**222. Biology of Forest Insects and Diseases.** Prerequisites: introductory courses in biology and physiology. One course. *Anderson and Stambaugh*

**233. General Entomology.** Prerequisite: Forestry 222 or equivalent. One course. *Anderson*

**241. Dendrology (Taxonomy of Forest Trees).** Prerequisite: introductory course in botany. One course. *White*

**250. Biometry.** Prerequisite: introductory courses in calculus. One course. *Yandle*

**269. Resource Economics and Policy.** Prerequisite: introductory course in economics. One course. *Convery*

### ENVIRONMENTAL STUDIES

**243. Natural Resource Ecology.** Prerequisite: introductory course in botany. One course. *Wuenschel*

**273. Economics and Environment Quality.** Prerequisite: introductory course in economics. One course. *Convery*

## French

For courses offered in French, see Romance Languages.

## Genetics—The University Program

Professor Gross, *Director* (Biochemistry); Professors Amos (Microbiology and Immunology), Gillham (Zoology), and Guild (Biochemistry); Associate Professors Antonovics (Botany), Boynton (Botany), Counce (Anatomy), C. Ward (Zoology), and Webster (Biochemistry); Assistant Professors Hall (Biochemistry), Kredich (Medicine and Biochemistry), and F. Ward (Microbiology and Immunology)

The University Program in Genetics provides a coherent course of study in all facets of biology related to genetics. Students interested in preparation for advanced work in genetics or wishing to take an interdisciplinary major in this area should consult Dr. C. Ward (032 Biological Sciences Building). Information concerning interdisciplinary programs involving biology should be discussed with the appropriate directors of undergraduate studies.

The following courses are described in the listing of the specified departments:

**Genetics and Society.** (Zoology 117.) One course. *Ward*

**Principles of Genetics.** (Botany 180 and Zoology 180.) One course. *Antonovics, Boynton, and Gillham*

**Principles of Genetics with Laboratory.** (Botany 180L and Zoology 180L.) One course. *Antonovics, Boynton, Gillham, and Ward*

**Evolutionary Mechanisms.** (Botany 186 and Zoology 186.) One course. *Antonovics and H. Wilbur (Zoology)*

**Molecular Genetics.** (Biochemistry 216.) One course. *Guild and Staff*

**Principles of Genetics.** (Botany 280 and Zoology 280.) One course. *Antonovics, Boynton, and Gillham*

**Experimental Genetics.** (Biochemistry 282.) Half course. *Hall and Staff*

**Current Topics in Genetic Mechanisms.** (Biochemistry 284.) Half course. *Hall and Staff*

**Population Genetics.** (Botany 285S.) One course. *Antonovics*

**Evolutionary Mechanisms.** (Botany 286 and Zoology 286.) One course. *Antonovics and H. Wilbur (Zoology)*

**Quantitative Genetics.** (Botany 287S.) One course. *Antonovics*

**The Cell in Development and Heredity.** (Anatomy 288 and Zoology 288S.) Half course. *Counce*

*Independent Study* and *Special Problems* are offered in the Department of Botany under 191, 192, 193, 194, 225, and 226, and in the Department of Zoology under 191, 192, 193, and 194. A student should obtain the consent of both the instructor with whom he wishes to work and the appropriate director of undergraduate studies before registering for these courses.

## Geography

For courses in Geography, see *Economics*.



# Geology

Professor Heron, *Chairman*; Associate Professor Furbish, *Director of Undergraduate Studies*; Professors Perkins and Pilkey; Associate Professor Lynts

**1. Geological Environments and Man.** Physical and chemical environments acting on the earth with special emphasis on their interaction with man. Three lectures and proficiency sessions to be arranged by students. One course. *Heron or Perkins*

**1P. Preceptorial.** Field trips. Four hours once a month on Saturday. Elective for students enrolled in Geology 1. *Staff*

**3. Environmental Geology.** Earth processes and materials, as related to man. Lectures, field-trip, and eight hours of mini-lab. Not open to those who have completed Geology 1. One course. *Heron*

**12. Geology, Resources, and Society.** Lectures, proficiency sessions, and field trips. Not open to students who have completed Geology 3. Prerequisite: Geology 1 or consent of instructor. One course. *Heron and Pilkey*

**53. Introductory Oceanography.** Basic principles of physical, chemical, biological, and geological oceanography. Prerequisite: one course in a laboratory science. (Also listed as Botany 53.) One course. *Pilkey and Searles (Botany)*

**54. Environmental Oceanography.** The interaction of man and the marine environment. Lecture and field trips. Given biennially. One course. *Pilkey*

**72. History of the Earth.** Physical and biological evolution of the earth from the viewpoint of the global tectonics. Primarily for science majors. Lectures, student-arranged laboratory sessions, weekend field trip through the Appalachians, and Saturday field trip through the Deep River Triassic Basin. Prerequisite: Geology 1 or consent of instructor. One course. *Lynts*

**101. Crystallographic Mineralogy.** Definition of the crystalline state, lattice and group concepts, indices, crystal systems, classification, and crystal morphology. Lectures and laboratory. One course. *Furbish*

**102. Fundamentals of Mineralogy.** Crystal chemistry, crystal physics, mineral identification, and genesis. Lectures or recitations, laboratory, and field trips. Prerequisites: Chemistry 12 (may be taken concurrently) and Geology 101. One course. *Furbish*

**106. Igneous and Metamorphic Rocks.** Silicate mineralogy, theory of origin and classification of igneous and metamorphic rocks, and rock identification. Lectures and laboratory. Prerequisite: Geology 102. One course. *Furbish*

**108. Sedimentary Rocks.** Authigenic and detrital minerals, theory of origin and classification of sedimentary rocks and rock identification. Lecture, laboratory, and field trips. Prerequisite: Geology 1. One course. *Heron*

**164. Introduction to Geologic Field Methods.** Principles and techniques used in geologic mapping and field studies including applicable methods of surveying and the use of aerial photographs. Lectures, laboratory, and field trips. Prerequisites: Geology 1 and 72. One course. *Furbish*

**169. The Marine Environment.** For description see Marine Sciences.

**171. Marine Sciences Seminar.** For description see Marine Sciences.

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors and seniors by consent of the Director of Undergraduate Studies. Two courses. *Staff*

**195. Problems in Earth Science.** Open to qualified non-major juniors and seniors upon approval of the department. One course. *Staff*

#### **For Seniors and Graduates**

**205. Geological Oceanography.** The study of the broad geologic aspects of the ocean basins, including origin, bottom physiology, sediment distribution, and sedimentary processes. Observations in the field will be emphasized and will include training in sampling procedures for both shallow and deep water. Not open to students who have completed Geology 206. Given at Beaufort. One and one half courses. (6 graduate units.) *Pilkey*

**206S. Principles of Geological Oceanography.** A survey of geological aspects of the oceans including sediment types, processes of sedimentation, geologic structures of the ocean basins, and bottom physiography. Prerequisite: Geology 108 or consent of instructor. One course. (3 graduate units.) *Pilkey*

**208. Shallow-Marine Geology.** Physical and biological processes responsible for sediment production, accumulation, and alteration in the shallow-marine environment. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. (3 graduate units.) *Perkins*

**211S. Stratigraphic Principles and Application.** Prerequisite: Geology 108. One course. (3 graduate units.) *Perkins*

**212. Facies Analysis.** Sedimentological models for the environmental interpretation of sedimentary sequences. Prerequisite: Geology 211. One course. (3 graduate units.) *Perkins*

**213. Sedimentology.** Parameters of sedimentation, sediment classification, and laboratory methods of analysis. Prerequisite: Geology 108 or consent of instructor. Given biennially. One course. (3 graduate units.) *Pilkey*

**214S. Sediments in Thin Section.** Study of sediments and sedimentary rocks using the petrographic microscope and related techniques. Prerequisite: Geology 213 or consent of instructor. One course. (3 graduate units.) *Perkins*

**222. Sedimentary Minerals.** Structure and geologic occurrences of selective detrital and authigenic minerals including the clay minerals. Theory and use of X-ray diffraction, differential thermal analysis, and thermal gravimetric analysis. Prerequisite: Geology 102 or consent of instructor. One course. (3 graduate units.) *Heron*

**229. Economic Geology.** Principles and processes involved when elements are concentrated to economic proportions in magmatic, metamorphic, hydrothermal, sedimentary, or surface environments. Prerequisites: Geology 102. Given on demand. One course. (2 graduate units.) *Furbish*

**230. Principles of Structural Geology.** Description, origin, and interpretation of primary and secondary geologic rock structures. Prerequisites: Geology 106 and 108. One course. (3 graduate units.) *Staff*

**233. Geochemistry.** Application of the principles of chemistry to the solution of problems in geology. Prerequisites: Geology 102 and Chemistry 12. One course. (3 graduate units.) *Staff*

**241-242. Invertebrate Paleontology.** Biologic and stratigraphic relationships of fossil invertebrates, with special emphasis on evolutionary trends of invertebrates as interpreted from fossil evidence. Lectures and laboratory. Prerequisites: Geology 1, 72, or consent of instructor. Given biennially. Two courses. (6 graduate units.) *Lynts*

**243-244. Micropaleontology.** Microscopic animal and plant fossils, exclusive of spores and pollen, with special emphasis on their biology, taxonomy, evolution, and stratigraphic distribution. Lectures and laboratory. Prerequisites: Geology 241-242, or consent of instructor. Given biennially. Two courses. (6 graduate units.) *Lynts*

**247. Paleogeology.** Application of ecologic and geologic principles to the reconstruction of the interrelationships between organisms and their environment in geologic time. Prerequisites: Geology 213, 242, or consent of instructor. Given biennially. One course. (3 graduate units.) *Lynts*

## DEPARTMENTAL MAJOR

### The A.B. Degree

*Prerequisites.* Geology 1 and 72, Chemistry 11 and 12, and Mathematics 31 and 32.

*Major Requirements.* A minimum of eight geology courses above the introductory levels, including 101, 102, 106, 108, 164, 211, and 230.

### The B.S. Degree

The Department of Geology offers two programs:

#### 1. Geology

*Prerequisites.* Geology 1 and 72, Chemistry 11 and 12, Mathematics 31, 32, and Computer Science 51.

*Major Requirements.* A minimum of ten courses above the introductory level including 101, 102, 106, 108, 211, 230, plus a field course normally taken during the summer of the junior year.

#### 2. Geology: Preparatory to Advanced Studies in Oceanography

*Prerequisites.* Geology 1 and 72, and 53 (or 206), Chemistry 11 and 12, Physics 51 and 52, Biology 11 and 12 or Biology 14, calculus and three courses of science electives.

*Major Requirements.* A minimum of seven geology courses above the introductory level, including 101, 102, 106, 108, 164, 211S, and 230.

## Germanic Languages and Literature

Professor Phelps, *Chairman*; Assistant Professor Bessent, *Director of Undergraduate Studies and Supervisor of Freshman Instruction*; Professor Jantz; Associate Professors Borchardt, Novak, and Rolleston; Assistant Professor Alt

**1-2. Elementary German.** Practice in understanding, speaking, reading, and writing. Classroom techniques are combined with those of the language laboratory. Two courses. *Bessent and Staff*

**63. Intermediate German.** Prerequisite: German 1-2 or equivalent. One course. *Staff*

German 63 is usually followed by 101, 117, or 182.

**101. Introduction to German Literature.** Readings from representative German authors. One course. *Bessent*

**103S, 104S. Seminars in German Literature in English Translation.** Topics to be specified each semester. Two courses. *Staff*

**105. Composition.** Syntax with practice in the elements of German expository style, restricted to majors. One course. *Staff*

**109S. Nineteenth Century Prose Fiction.** Emphasis on shorter forms: novel, fairytale, legend. One course. *Alt or Borchardt*

**115S. Drama (1770-1890).** History of German drama and stagecraft from *Sturm und Drang* to the *Freie Bühne*. One course. *Alt*

**117S, 118S. German Conversation and Composition.** Primarily conversation with oral and written reports, based on works by contemporary writers of East and West Germany. Required for German majors; other students by consent of instructor. Two courses. *Bessent*

**119S. German Literature to the Goethezeit.** Survey of German literature and its cultural backgrounds from the beginning through the Enlightenment. One course. *Alt or Rolleston*

**125, 126. The Moderns.** Problems and authors from Nietzsche and naturalism through expressionism to the present. Two courses. *Alt or Rolleston*

**127. Contemporary Germany.** The current literary scene in the two Germanies in its cultural, social, and political contexts. One course. *Staff*

**130. German Life and Thought.** German cultural and intellectual history. Reading and discussion in English. One course. *Borchardt*

**131. Goethezeit.** Goethe and his contemporaries: representative texts and the philosophical background. One course. *Phelps*

**132. The Romantics.** Major writers of the Romantic movement (1796-1830) considered in their national and international context. One course.

**133S. The Lyric.** Development of German lyric poetry from Goethe to Rilke. One course. *Alt or Rolleston*

**171. German Literature before 1900 in English Translation.** One course. *Borchardt*

**172. Modern German Literature in English Translation.** Representative works by such writers as Mann, Kafka, Hesse, Brecht, Böll, and Grass. One course. *Borchardt*

**181, 182. German.** An intensive introduction to the language open only to students who have achieved proficiency in another language. Two courses. *Staff*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified students in the junior year, by consent of the department. Two courses. *Alt, Bessent, Borchardt, Phelps, or Rolleston*

**193, 194. Independent Study.** Directed reading and research. Open only to qualified students in the senior year, by consent of the department. Two courses. *Alt, Bessent, Borchardt, Phelps, or Rolleston*

## YIDDISH

**171. Yiddish Fiction in English Translation.** Representative works of the classics (Mendele, Peretz, Sholem Aleikhem, Asch, Goldfaden) as well as of selected poets. One course. *Alt*

**181, 182. Elementary Yiddish.** A thorough study of elementary Yiddish grammar with reading, composition, and oral practice. No previous knowledge of German or Hebrew required. Two courses. *Alt*



**191, 192. Independent Study.** Two courses. *Alt*

### **For Seniors and Graduates**

**201S, 202S. Goethe.** His life and works, in the light of his lasting significance to Germany and world literature. First semester: lyrics, prose, fiction, and selected dramas; second semester: *Faust* I & II. Two courses. (6 graduate units.) *Phelps*

**203S, 204S. Eighteenth Century.** Eighteenth century German literature in its relation to European intellectual currents of that time. Two courses. (6 graduate units.) *Phelps*

**205, 206. Middle High German.** The language and literature of Germany's first classical period. Two courses. (6 graduate units.) *Borchardt*

**207S, 208S. German Romanticism.** The principal writers of the period from 1800 to 1850. Two courses. (6 graduate units.)

**209S, 210S. Kleist, Grillparzer, and Hebbel.** The development of the drama in Germany and Austria between Schiller and Naturalism. Two courses. (6 graduate units.) *Alt*

**211S, 212S. Nineteenth Century Literature.** From the end of Romanticism through Realism. Two courses. (6 graduate units.) *Alt*

**213S. Heinrich Heine.** The poet and his impact on his age. One course. (3 graduate units.)

**214S. The Twentieth Century.** Literature of the twentieth century presented through representative authors. One course. (3 graduate units.) *Rolleston*

**215S. Seventeenth Century Literature.** Leading writers of the Baroque, viewed against the background of their time. One course. (3 graduate units.) *Borchardt*

**216. History of the German Language.** Development of the phonology, morphology, and syntax of German from earliest beginnings to the present. One course. (3 graduate units.)

**217S. Renaissance and Reformation Literature.** The period from 1400 to about 1600. One course. (3 graduate units.) *Borchardt*

**218S. The Teaching of German.** A survey of modern teaching techniques; problems in the teaching of German on the secondary and college levels. Analysis and evaluation of textbooks and related audiovisual materials. One course. (3 graduate units.) *Phelps*

**219. Applied Linguistics.** The application of modern linguistic principles to a systematic study of the phonetics, morphology, and syntax of modern German. Prerequisite: consent of the instructor. One course. (3 graduate units.)

**232. Criticism.** Critical concepts, craft of interpretation, and readings from the great critics. One course. (3 graduate units.) *Alt or Borchardt*

**233. Advanced Composition.** Intensive study of syntax; practice in the writing of German prose, aiming toward the development of an expressive and fluent style. One course. (3 graduate units.)

### **DEPARTMENTAL MAJOR**

*Prerequisites.* Elementary and Intermediate German.

*Major Requirements.* Conversation and Composition (German 117, 118, or

equivalent), plus six advanced courses, three of which must be on the 200-level. The following courses may not be used to fulfill major requirements: 103S, 104S, 171, 172, 181, 182.

*Honors.* Any student who is qualified (see the section on Honors in this *Bulletin* for general requirements) may undertake work toward a degree with distinction in German by applying to the chairman or departmental representative for the honors program. In addition to meeting the requirements of a major in the department, the candidate for graduation with distinction is encouraged to take one or more courses in Independent Study and German 232. Further information is available at the departmental office, 104 Languages Building.

## Greek

For courses in Greek, see *Classical Studies*.

## Health, Physical Education, and Recreation

Professor Friedrich, *Chairman*; Associate Professor Skinner, *Director of Undergraduate Studies*; Professors Bookhout, Buehler, and Falcone; Associate Professors Corrie, Cox, Eddy, Persons, Spangler, Uhrhane, and Woodyard; Assistant Professors Harvey, LeBar, Lloyd, Raynor, Riebel, and Wray; Instructors Howard and White; Part-time Instructors Barton and Myers

### PHYSICAL EDUCATION ACTIVITY COURSES

The activity courses listed below may be taken by men and women unless otherwise indicated. Each course carries a half course credit and is given on a pass/fail basis. The maximum amount of credit which a student may earn for elective activity courses is one full course.

**4. Beginning and Intermediate Equitation.** Including trail riding for those with good control in the canter. Experience unnecessary. Fee of \$96 covers twenty-four mounted lessons and one in stable management. Half course. *Swanson*

**6. Equitation: Hunt Seat.** Riding according to U. S. Pony Club standards. Position at all paces, increase and decrease of pace, turns, circles, jumping. Trail rides. Fee of \$110 for twenty-four mounted lessons and two on saddlery. Half course. *Gosling*

**7. Equitation: Combined Training.** Dressage, crosscountry, and stadium jumping. Prerequisites: ownership of horse; the United States Combined Training Preliminary Level or the United States Pony Club "B" rating. Fee of \$50 per semester. Half course. *Gosling*

**11,12. Adapted Physical Education.** Exercises, conditioning, or special activities to meet needs of individual students. Two half courses. *Riebel*

**14. Tension Control.** Basic skills and practice in recognizing, controlling and reducing tension. Techniques including Jacobson's Progressive Relaxation, autogenic procedures, and meditative methods. Half course. *Riebel*

**15. Individual Development: Aerobics, Weight Training, Conditioning.** A planned program of progressive, cumulative, and measurable physical activities adapted to individual needs. Designed to increase fitness. Half course. *Staff*

**16. Jogging.** Emphasis on individualized programs. Half course. *Buehler*

**20. Beginning Swimming.** Techniques for water safety: breathing control, floating, and elementary swimming. Half course. *Staff*

**21. Intermediate Swimming.** Stroke techniques and diving. Resuscitation. Prerequisite: Physical Education 20 or the equivalent. Half course. *Staff*

**22. Endurance Swimming.** Review of strokes and improvement through progressive practice. Half course. *Spangler*

**23. Beginning Kayaking.** Development of all phases of single kayaking. Lake and river experience provided. Half course. *Harvey*

**24. Advanced Lifesaving: New Materials of American Red Cross.** ARC Advanced Lifesaving Certificate issued upon satisfactory completion. Prerequisite: Physical Education 21 or equivalent. Half course. *Staff*

**25. Water Safety Instructors Course: New Materials of American Red Cross.** ARC Water Safety Instructors Certificate upon satisfactory completion. Prerequisite: Physical Education 24 or equivalent. Half course. *Staff*

**26. Advanced Swimming and Water Safety.** Swimming as an avocation or vocation. Prerequisite: Physical Education 24 or 25, or equivalent. Half course. *Persons*

**27. Scuba Diving.** An intermediate course. Prerequisite: consent of the instructor. Fee of \$10 covers use of specialized equipment. Half course. *Staff*

**28. Whitewater Canoeing.** Fee covers rental of equipment. Prerequisite: departmental swim test. Half course. *Riebel*

**29. Beginning Sailing.** On campus and Kerr Lake. Prerequisite: departmental swim test. Half course. *Buehler*

**30. Beginning Golf.** Fee. Half course. *Staff*

**31. Intermediate and Advanced Golf.** Wood shots, iron shots, approaching, and putting. Fee. Prerequisite: Physical Education 30 or equivalent. Half course. *Staff*

**32. Handball, Racquet Ball, Squash.** No previous experience necessary. Half course. *Skinner*

**33. Fencing.** Basic skills emphasizing foil fencing. Half course. *LeBar*

**37. Archery, Badminton.** Archery in good weather; badminton in poor weather. Competition. No previous experience necessary. Half course. *Staff*

**38. Snow Skiing.** Basic instruction in techniques of snow skiing. Fee of \$80 covers rental of equipment, daily slope fees, housing for five nights, and daily instruction on slopes and at ski lodge. Half course. *Riebel*

**39. Bowling: Beginning and Advanced Techniques.** Fee. Half course. *Corrie and Spangler*

**40. Beginning Tennis.** Half course. *Staff*

**41. Intermediate Tennis.** Introduction to volley, lob, and smash. Competition in singles and doubles. Prerequisite: Physical Education 40 or equivalent. Half course. *Staff*

**42. Advanced Tennis.** Review of strokes with emphasis on strategy and placement. Singles and doubles competition. Prerequisite: Physical Education 41 or equivalent. Half course. *Staff*

**43. Power Volleyball.** Introduction to the basic skills. Half course. *Staff*

**45. Trampoline and Floor Exercise.** Beginning skills and techniques. Half course. *Staff*

**46. Women's Gymnastics.** Introduction to balance beam, vaulting, and uneven parallel bars; emphasis on competitive gymnastic skills. Half course. *Staff*

**48. Self-Defense.** Course content varies: boxing, wrestling, judo, karate, or tae kwan-do. Half course. *Falcone and Staff*

**50. Field Hockey.** Basic skills. Conditioning, rules, and analysis of strategy. Half course. *Staff*

**51. Soccer, Lacrosse.** Fundamentals of individual skills and team play. Half course. *Skinner*

**52. Women's Lacrosse.** Basic skills. Half course. *Staff*

**53. Basketball.** Basic and advanced skills. Half course. *Staff*

**91. First Aid.** Knowledge and practical skill for dealing with emergency situations, for personal safety, and accident prevention. Meets American Red Cross requirements for the Standard First Aid and Personal Safety Certificate. Half course. *Lloyd*

## **THEORY COURSES IN PHYSICAL EDUCATION AND RECREATION**

**102. Physical Education for Early Childhood.** Theory and practice in teaching basic skills, rhythms, and games to young children in grades K-3. Half course. *Spangler*

**103. Physical Education for the Intermediate Grades.** Planning, organizing, and conducting physical education programs for children in grades 4-9. Half course. *Spangler*

**105. Group Leadership in Recreation.** Interaction and group dynamics. Open to sophomores, juniors, and seniors. One course. *Staff*

**106 Methods and Materials in Recreation.** Development of leadership skills in crafts, rhythmic activities, social recreation, and dramatics. Laboratory work includes experience with an organized recreational group. Open to sophomores, juniors, and seniors. One course. *Staff*

**113D. Anatomical Bases for Human Movement.** The function of bones, joints, and muscles in human movement. One course. *Bookhout*

**114. Kinesiology.** A study of muscle function and analysis of human movement. Prerequisite: Physical Education 113D or Zoology 53. One course. *Bookhout*

**117. Adapted Physical Education.** Analysis of exercises and activities appropriate to individual needs. Theory and practice in planning and conducting adapted programs. Half course. *Bookhout*

**146. Women in Sports.** Emergence of women in sports. Changing social concepts affecting the status of the woman athlete and her participation in sports. One course. *Lloyd*

**163. Coaching Baseball and Track in Secondary Schools.** Theory and practice. Open to juniors and seniors. One course. *Buehler and Butters*

**164. Coaching Basketball and Football in Secondary Schools.** Theory and practice. Open to juniors and seniors. One course. *Falcone and Foster*

**170. History and Principles of Physical Education and Sports.** The objec-



tives and scientific principles upon which physical education is based. The history of physical education is studied to show the changes in objectives, principles, and methods as an aid in the interpretation of trends. One course. *Friedrich*

**171. Recreational Administration and Leadership.** Theories and philosophies of play and recreation with emphasis on leadership and application to community organizations, school, and family situations. One course. *Friedrich*

**172. The Administration of Physical Education and Athletics in Secondary Schools.** A case study of appraisal of athletics, health, and physical education problems experienced in the organization and administration of athletics, health, and physical education. Open to juniors and seniors. One course. *Friedrich*

**173. Protective Practices in Physical Education.** Safety and protective measures, including training and rehabilitation. Open to juniors and seniors. One course. *Staff*

**191. Independent Study.** Open to qualified juniors and seniors. One course. *Staff*

**192. Independent Study.** Open to qualified juniors and seniors. One course. *Staff*

**195S. Recent Research in Physical Education and Related Fields.** One course. *Staff*

## HEALTH EDUCATION

**134. School Health.** Organization of the health program; basic health problems in school; methods and materials for teaching about health. Primarily designed for students preparing to teach in elementary or secondary schools. Juniors and seniors only. Half course. *Uhrhane*

**137S. Health in Developing Countries.** Health conditions, practices, and problems interacting with economics, productivity, and progress of emerging nations with some emphasis on African states. One course. *Uhrhane*

**138S. Health Problems in Metropolitan Areas.** Relationships between urbanization, and health illustrated by environmental hazards, population motion, food distribution, housing, city planning, poverty, drug usage, and consumer awareness. One course. *Uhrhane*

**140S. Gerontology and Health.** Health implications in relationships within families and between generations, in the changing role of the elderly in modern society, in retirement, and in extended leisure time; illness, disability, and medical care. One course. *Uhrhane*

**170T. Special Health Problems.** Problems and issues in health affairs selected by students for concentrated study. One course. *Uhrhane*

**174. School Health Problems.** Emphasizes health problems of school age children. Drugs, alcohol, tobacco, disease, and accident prevention and control, mental and emotional health, and healthful school environment. One course. *Friedrich*

**191, 192, 193, 194. Independent Study.** Prerequisite: consent of instructor. One course each. *Uhrhane*

## DANCE

Technique and theory courses are offered for undergraduate men and women who have special interest in dance as an art form.

### Technique Courses

**60. Beginning Modern Dance I.** Modern dance as an art form: techniques, choreography, history, philosophy, and aesthetics. Half course. *Wray*

**61. Beginning Modern Dance II.** Prerequisite: Physical Education 60. Half course. *Wray*

**62. Intermediate Modern Dance I.** Movement and expression. Prerequisite: Physical Education 61. Half course. *White*

**63. Intermediate Modern Dance II.** Prerequisite: Physical Education 62. Half course. *White*

**64. Advanced Modern Dance.** Prerequisite: Physical Education 63. Half course. *White*

**65. Beginning Improvisation.** Movement experimentation. Prerequisite: Physical Education 61. Half course. *White*

**66. Modern Dance Repertory.** Choreography of the well-known artists. Prerequisite: Physical Education 64. Half course. *Staff*

**67. Folk Dancing.** Dances of a particular country or area and study of related music, folklore, and costumes. Half course. *Wray*

**68. Ballroom Dancing.** Waltz, foxtrot, jitterbug, tango, samba, cha-cha, and polka. Half course. *White*

**69. Beginning Tap Dancing.** Basic step patterns and routines. Half course. *White*

**70. Ballet.** Prerequisite: one year of training in the strict classical form. Half course. *Staff*

**71. Intermediate Ballet.** Prerequisite: two years of ballet and consent of instructor. Half course. *Staff*

### Theory Courses

The courses listed below are in the areas of dance history, composition, teaching, and non-verbal communication. Courses 130S, 131S, 133S meet distributional requirements in the social science division. Physical Education 113D and 114, listed under the Physical Education Theory Courses, are closely related to the study of dance.

**130, 131S, 133S. History of Dance.** Emphasis on form, structure, and content related to culture of eras. Physical Education 130S, prehistoric to Duncan; Physical Education 131S, Duncan to Cunningham; Physical Education 133S, Cunningham to the present. Three courses. *White or Wray*

**132. Creative Movement for Children.** Basic theory and experience in creative movements for grades K-12. The study of the classification and elements of movement with observation and practical experience with children. Recommended for those students interested in dance, music, recreation, or elementary and secondary teaching. One course. *Wray*

**135, 136. Principles of Contemporary Dance Composition.** Prerequisite: Physical Education 60, 61, and 62, or consent of instructor. Two courses. *White*

**139. Movement Connotations.** Theories and forms of human movement with emphasis on sensory awareness and non-verbal communication. One course. *Wray*

**191, 192. Independent Study.** Open to qualified juniors and seniors. Two courses. *White or Wray*

## History

Professor Durden, *Chairman*; Professor Hollyday, *Director of Undergraduate Studies*; Professors Alden, Colton, Ferguson, Holley, Lerner, Parker, Preston, Ropp, A. Scott, W. Scott, TePaske, Watson, and Young; Associate Professors Cahow, Cell, Chafe, Davis, Hartwig, Mauskopf, Miller, Nathans, Witt, and Wood; Assistant Professors Bergquist, Calkins, Decker, di Corcia, Dirlik, Gavins, J. Scott, and Stone; Instructor Kunst; Adjunct Assistant Professor Goodwyn; Visiting Professor Brown; Visiting Assistant Professor Nation; Part-time Lecturer Kuniholm; Part-time Instructor Gordon

### PREREQUISITE COURSES

Majors take a year sequence of two prerequisite courses in history (21-22, 21S-22S, 53-54, 91-92, 175D-176D), beginning either semester. Other students are urged, but not required, to take two semesters of prerequisite courses before proceeding to advanced-level courses. Additional courses may be chosen from this group as electives or part of the departmental major.

**21. Europe to the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Staff*

**21S. Europe to the Eighteenth Century.** A seminar version of History 21. One course. *Staff*

**22. Europe From the Eighteenth Century.** Development and world impact of European civilization; critical evaluation of historical interpretations; investigation of history from primary sources. One course. *Staff*

**22S. Europe From the Eighteenth Century.** A seminar version of History 22. One course. *Staff*

**53. Greek History.** (Also listed as Classical Studies 53.) One course. *Raschke*

**54. Roman History.** (Also listed as Classical Studies 54.) One course. *Raschke*

**91. The Development of American Democracy to 1865.** A study of the trends vital to an understanding of the United States today. The main theme is the development of American Democracy. Problems of foreign policy, the growth of capitalism, political practices, social reform, and conflicting ideals are considered in relation to this main theme. One course. *Staff*

**92. The Development of American Democracy, 1865 to the Present.** A continuation of History 91 with emphasis upon the emergence of contemporary problems in the United States. One course. *Staff*

**175D, 176D. From Tradition to Revolution.** Social, political, and economic changes in Africa, India, Pakistan, Bangla Desh, Latin America, China, and Japan. Social and political organizations, belief systems, and environmental settings. Two courses. *Staff*

## OTHER UNDERGRADUATE COURSES

**101, 102. Introduction to the Civilizations of Southern Asia.** (Also listed as Interdisciplinary Course 101, 102.) One course. *Calkins*

**103. The Economic, Social, and Political Institutions of Europe, 1250-1600.** One course. *Witt*

**104. The Intellectual Life of Europe, 1250-1600.** One course. *Witt*

**105, 106. Political and Constitutional History of England.** The origins and evolution of the principal institutions of the English government, related to their setting in a changing society. Two courses. *J. Scott*

**107, 108. Social and Cultural History of England.** English history from the fourteenth century to the present time in an effort to arrive at a synthesis of ideas, social conditions, and political events and thus provide a background for the study of English literature. Two courses. *Ferguson*

**111, 112. The Colonial History of the United States and the American Revolution.** Two courses. *Wood*

**113, 114. The United States from the 1890's to World War II.** First semester to 1920. Second semester through the New Deal. Two courses. *Watson*

**115, 116. History of Africa.** Social, political, and economic development in tropical Africa. First semester: cultural background and pre-colonial history. Second semester: colonial and contemporary times. Two courses. *Hartwig*

**117, 118. European Imperialism and Colonialism.** The age of discovery, the new imperialism, and modernization of post-colonial societies. Two courses. *Cell*

**119, 120. History of Socialism and Communism.** The origins and development of socialist and communist movements from pre-Marxian times to the present. Two courses. *Lerner*

**121, 122. Diplomatic History of the United States.** Emphasis on those factors, foreign and domestic, that have shaped the foreign policies of the Republic. Two courses. *Davis*

**123, 124. City and Frontier in United States History.** The westward movement and the progress of urbanization with attention to the social and political consequences. Two courses. *Decker or A. Scott*

**125. The Athenian Empire.** (Also listed as Classical Studies 134.) One course. *Staff*

**126. Alexander the Great.** (Also listed as Classical Studies 135.) One course. *Staff*

**127. The Hellenistic Kingdoms.** (Also listed as Classical Studies 136.) One course. *Staff*

**128. The United States and Latin America.** Economic, cultural, political, and diplomatic relationships in the twentieth century. One course. *Bergquist*

**129, 130. Society and Government in the United States 1789-1877.** Two courses. *Nathans*

**131. Mexico and the Caribbean from the Wars of Independence to the Present.** One course. *TePaske*

**132. Major South American Nations, 1850 to the Present.** Comparative de-



velopment of export economies of Brazil, Argentina, Colombia, Chile, and Venezuela and impact on social structure, politics, and culture. One course. *Bergquist*

**133. Medieval Europe, 300-1000 A.D.** One course. *Young*

**134. Medieval Europe, 1000-1400 A.D.** One course. *Young*

**135, 136. Europe in the Twentieth Century.** Political, economic, and intellectual developments in Europe since 1900. First semester: to 1933. Second semester: to the present day. Two courses. *Colton*

**137, 138. Foreign Relations of the European Powers.** European diplomacy and Europe's position in the world since 1870, with an introductory survey of diplomatic institutions since the Renaissance. Two courses. *W. Scott*

**139. Europe in the Age of National Unification.** Clash of nationalities, conflict between monarchic conservatism and liberalism, romanticism and realism in literature and art; emphasis on central Europe from Metternich to 1871. One course. *Hollyday*

**140. Europe in the Era of German Ascendancy.** International tensions, industrialization, socialism, state intervention, Darwinism, expressionism in art and literature, crises in Imperial Germany and Austria-Hungary from Bismarck to the collapse in 1918. One course. *Hollyday*

**141. Man and Society in Traditional China.** Chinese thought and institutions from earliest times to the nineteenth century. One course. *Dirlik*

**142. The Roots of the Revolution.** Nineteenth and twentieth century China. One course. *Dirlik*

**143, 144. History of Modern Japan.** Japan from 1600 to the present; the transition from the traditional to the modern state. Two courses. *Stone*

**145, 146. Afro-American History.** The Black experience in America from slavery to the present. (Also listed as Black Studies 83, 84.) Two courses. *Gavins*

**147. History of India to 1707.** Early development, classical Hindu civilization, the impact of Islam, first modern contacts. One course. *Calkins*

**148. History of India and Pakistan, 1707 to the Present.** Decay of the Mughal Empire, social and economic impact of Western rule, development of nationalism and independence. One course. *Calkins*

**149. Military History.** War, politics, and technology. One course. *Ropp*

**150S. The Concept of the Democratic Faith.** One course. *Cahow*

**151. Modern Technology.** Emphasis on Western technology in the nineteenth and twentieth centuries as related to political, economic, and scientific trends. One course. *Ropp*

**152. Modern Mexico.** A problem-oriented interdisciplinary approach based upon literature, history, the fine arts, and films. Readings in English or Spanish. (Also listed as Spanish 152.) One course. *Fein and TePaske*

**153S. The Insurgent South.** (Also listed as Interdisciplinary Course 153S.) Not open to students who have taken History 199 or Interdisciplinary Course 199. Prerequisite: consent of instructor. One course. *Goodwyn*

**154. Medieval England.** One course. *Young*

**155, 156. Modern Latin America.** First semester: nineteenth century. Second semester: twentieth century. Two courses. *Bergquist*

**157, 158. The Rise of Modern Science.** The development of science and medicine, with attention to cultural and social influences upon science. First semesters: through Newton. Second semester: eighteenth to twentieth centuries. Two courses. *Mauskopf*

**159S. The Palestine Problem and United States Public Policy.** (Also listed as Public Policy Studies 175S.) One course. *Kuniholm*

**160. The United States from the New Deal to the Present.** One course. *Chafe*

**161, 162. History of Modern Russia.** First semester: origins of Kievan Russia in the ninth century through the reign of Catherine the Great (1762-1796), concentrating on the formation of the imperial state, class elites, and psychological interpretations of the rulers. Second semester: nineteenth and early twentieth century to the death of Lenin, stressing the opposition movements in society. Two courses. *Miller or Nation*

**163, 164. Reform and Politics in Nineteenth Century United States.** First semester: the coming of the Civil War, with emphasis on the reform movements of the Jackson era, the anti-slavery crusade, and national politics to 1861. Second semester: reform and politics from the war and Reconstruction era to the Farmers Revolt of the 1890's. Two courses. *Durden*

**167, 168. Modern European Intellectual and Cultural History.** Leading European thinkers from the Enlightenment to the present. Two courses. *Parker*

**169, 170. The Search for the American Woman: A New Approach to Social History.** Prerequisite: History 91, 92. Two courses. *A. Scott*

**173, 174. History of Spain and the Spanish Empire from Late Medieval Times to the Present.** First semester: unification and development of the empire in Europe and America, emphasizing colonial institutions and culture, 1450-1670. Second semester: fall of the empire and modern development through the Franco Regime. Two courses. *TePaske*

**175D, 176D. From Tradition to Revolution.** (See description under prerequisites above.) Two courses. *Staff*

**177. China since 1949: The Peoples' Republic.** The Chinese path to communism and the communist transformation of Chinese society. One course. *Dirlik*

**178. Diplomacy of the United States Since 1939.** One course. *Davis*

**179, 180. Bourbon, Revolutionary, and Napoleonic France.** Development of the Bourbon monarchy and social self-conceptions; causes, patterns, and meanings of the Revolution; Napoleon's relation to Bourbon and Republican France and to Europe. Two courses. *di Corcia*

**181, 182. Development of Modern Medicine.** Two courses.

**183S. Canada from the French Settlement.** Problems in the development of Canada and its provinces. One course. *Preston*

**184. Canada: Problems and Issues of an Advanced Industrial Society.** (Also listed as Interdisciplinary Course 184.) One course. *Preston and Visiting Lecturers*

**185, 186. Revolution in the Modern World.** Survey of theories of revolution (Marxist, sociological, and historical), followed by a comparative study of the great revolutions (English, American, French, Russian) and of the revolution and resistance to colonialism in the Third World (including Cuba, Africa, India, China, and Vietnam). Two courses. *Cell*

**187. Canada and the United States: Their Diplomatic Relations.** One course.  
*Davis*

**188. History of the Middle East, 1789 to the Present.** The decline of the multinational Ottoman Empire and the emergence of Turkish, Arab, and Jewish national states after World War I. One course.

### **For Seniors and Graduates**

Students may receive credit for either semester of a hyphenated course at the 200-level without taking the other semester if they obtain written consent from the instructor.

**201S, 202S. Aspects of Change in Prerevolutionary Russia.** Origin and dynamics of the Russian revolutionary movement, the intelligentsia, and the emergence of the labor movement. Two courses. (3 graduate units per semester.) *Miller*

**203. The Uses of History in Public Policy Making: I.** (Also listed as Public Policy Sciences 271.) One course. (3 graduate units.) *Goodwyn*

**204. The Uses of History in Public Policy: II.** (Also listed as Public Policy Sciences 273.) One course. (3 graduate units.) *Kuniholm*

**207, 208. The Development of Urban America.** The process of urbanization from rural society to the modern city. Two courses. (3 graduate units per semester.) *Decker or A. Scott*

**209, 210. Selected Topics in Afro-American History, 1619-Present.** Critical issues of the collective experience of Afro-Americans with special attention to Black institutional development. (Also listed as Black Studies 209, 210.) Two courses. (3 graduate units per semester.) *Gavins*

**212. Recent Interpretations of United States History.** A course designed to encourage a critical evaluation of major issues in United States history through examination of recent interpretations of key problems. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. (3 graduate units.) *Watson and Staff*

**215-216. The Diplomatic History of the United States.** (Not open to undergraduates who have had History 121-122.) Two courses. (6 graduate units.) *Davis*

**217, 218. Recent European History.** Two courses. (3 graduate units per semester.) *Brown*

**221. Problems in the Economic and Social History of Europe, 1200-1700.** One course. (3 graduate units.) *Witt*

**222. Problems in European Intellectual History, 1250-1550.** One course. (3 graduate units.) *Witt*

**223S, 224S. The Old Regime, the Enlightenment, and the French Revolution.** Political, social, and intellectual trends in seventeenth and eighteenth century Europe, with emphasis on France and the French Revolution. Two courses. (3 graduate units per semester.) *di Corcia*

**227-228. Recent United States History: Major Political and Social Movements.** Two courses. (6 graduate units.) *Chafe*

**229. Recent Interpretations of Modern European History.** A course designed to develop the ability to appraise critical historical issues through the study and discussion of recent interpretations of key historical problems in modern Euro-

pean history. (Open only to history graduate students and seniors doing practice teaching in one of their final two semesters.) One course. (3 graduate units.) *Parker*

**231S, 232S. Problems in the History of Spain and the Spanish Empire.** Two courses. (3 graduate units per semester.) *TePaske*

**237S. Europe in the Early Middle Ages.** One course. (3 graduate units.) *Young*

**238S. Europe in the High Middle Ages.** One course. (3 graduate units.) *Young*

**240. Aspects of Traditional and Modern African Culture.** Introduction to the oral and written literatures and musical and artistic traditions. One course. (3 graduate units.) *Hartwig*

**241-242. Modernization and Revolution in China.** Two courses. (6 graduate units.) *Dirlik*

**247. History of Modern India and Pakistan, 1707-1857.** Analysis and interpretation, with special emphasis on social and economic change. One course. (3 graduate units.) *Calkins*

**248. History of Modern India and Pakistan, 1857 to the Present.** One course. (3 graduate units.) *Calkins*

**249-250. Social and Intellectual History of the United States.** The interplay of ideas and social practice through the examination of attitudes and institutions in such fields as science and technology, law, learning, and religion. Two courses. (6 graduate units.) *Holley*

**253, 254. Modern European Intellectual History.** Two courses. (6 graduate units per semester.) *Parker*

**255S-256S. Problems in African History.** Two courses. (6 graduate units.) *Hartwig*

**257S, 258S. Modern East Asia: Introduction to Problems and Literature.** (Also listed as Interdisciplinary Course 257S, 258S and Political Science 257S, 258S.) Two courses. (3 graduate units per semester.) *Dirlik, McKean, and Stone*

**260. Economic History of Japan.** (Also listed as Economics 232.) One course. (3 graduate units.) *Bronfenbrenner*

**261-262. Problems in Soviet History.** Studies in the background of the Revolution of 1917 and the history and politics of the Soviet state. Two courses. (6 graduate units.) *Lerner*

**263-264. American Colonial History and the Revolution, 1607-1789.** The founding and institutional development of the English colonies; the background, progress, and results of the Revolution. Two courses. (6 graduate units.) *Wood*

**265S, 266S. Problems in Modern Latin American History.** Two courses. (3 graduate units per semester.) *Bergquist*

**267S-268S. From Medieval to Early Modern England.** The intellectual, social, and political problems of transition to modern England, with special emphasis on the English Renaissance. Two courses. (6 graduate units.) *Ferguson*

**269-270. British History, Seventeenth Century to the Present.** Historiography of social structure and social change: English Revolution, party, the



Industrial Revolution, class and class consciousness, Victorianism, and the impact of war in the twentieth century. Two courses. (6 graduate units.) *Cell*

**273, 274. Topics in the History of Science.** Critical stages in the evolution of scientific thought. Two courses. (3 graduate units per semester.) *Mauskopf*

**275S, 276S. Central Europe, 1848-1918.** Conflict between liberalism and authoritarianism, clash of nationalities, diplomatic interaction, emphasizing domestic changes in Germany and Austria-Hungary. Two courses. (3 graduate units per semester.) *Hollyday*

**277S. The Coming of the Civil War in the United States, 1820-1861.** One course. (3 graduate units.) *Durden*

**278S. The Civil War in the United States and its Aftermath, 1861-1900.** One course. (3 graduate units.) *Durden*

**279S. Oral History.** Techniques applied to social attitudes and problems in the United States. Prerequisite: consent of instructor. One course. (3 graduate units.) *Goodwyn*

**280. Historiography.** Great historians since Herodotus and an examination of recent twentieth century trends. One course. (3 graduate units.) *Parker*

**283-284. Political and Social Change in the United States, 1789-1800.** Two courses. (6 graduate units.) *Nathans*

**287-288. History of Modern Japan.** The political, economic, and social development of Japan since 1750; factors contributing to Japan's emergence as a modern state. Two courses. (6 graduate units.) *Stone*

**297S. The British Empire of the Nineteenth Century.** The development of the Empire from the American Revolution to the imperialism that culminated in the South African War. One course. (3 graduate units.) *Preston*

**298S. The Commonwealth in the Twentieth Century.** The origins and evolution of the Commonwealth of Nations and its adjustment in the age of anti-colonialism. One course. (3 graduate units.) *Preston*

## **SMALL/GROUP LEARNING EXPERIENCE**

(For discussion sections, see History 175D, 176D.)

### **Tutorial**

**189T, 190T. Tutorial in History.** Two courses. *Staff*

### **Independent Study**

Independent study is usually undertaken by students concurrently with a course or with an instructor with whom they have had a course. Students should submit to the instructor in writing a detailed description of intent in the study. Both the instructor's consent and approval of the Director of Undergraduate Studies are required for enrollment.

**191, 192. Independent Study.** One or two courses each. *Staff*

### **Undergraduate Seminars**

(See also History 21S, 22S, 150S, 153S, 159S, 183S.)

**165S-166S. Seminar in Selected Topics.** Course content determined by instructor: consent of instructor is required. Two courses. *Staff*

The following seminars offer opportunities for reading and historical investigation in significant problems. Juniors as well as seniors may apply for admission to these courses and are urged to do so if they expect to practice teach in their senior year. All seminars are open to majors and nonmajors.

**195A-196A. Renaissance Intellectual History.** Studies in the transformation of European thought between 1300 and 1600. Two courses. *Witt*

**195B-196B. Twentieth Century Europe.** Two courses. *Colton*

**195C-196C. Problems in the Social and Intellectual History of the United States.** Two courses. *Holley*

**195D-196D. Problems in Twentieth Century United States History.** Two courses. *Chafe or Watson*

**195E-196E. The Age of the American Revolution.** Two courses. *Wood*

**195F. The Coming of the Civil War in the United States, 1820-1861.** One course. *Durden*

**196F. The Civil War in the United States and Its Aftermath, 1861-1900.** One course. *Durden*

**195G-196G. Nationalism and Communism in the Far East.** Two courses. *Dirlik*

**195H-196H. From Rural to Urban Society in the United States.** Two courses. *Decker or A. Scott*

**195I. The Emergence of Germany, 1815-1871.** One course. *Hollyday*

**196I. The German Empire and Europe, 1871-1918.** One course. *Hollyday*

**195J-196J. History of International Socialism to the First World War.** Evolution of socialist thought from early nineteenth century Utopian theory through Marxist and anarchist ideologies; the relationship of socialist parties and leaders to the First and Second Internationals. Two courses. *Miller*

**195K-196K. Social Change in Modern Britain.** Two courses. *Cell*

**195L. Causes of Revolution: Search for a Model.** One course. *Cell*

**195M-196M. Europe and the World Since 1914.** Two courses. *W. Scott*

**195N-196N. The English Renaissance.** Two courses. *Ferguson*

**195P-196P. England in the Ages of the Puritan and American Revolutions.** Two courses. *J. Scott*

**195R. The Age of Newton.** One course. *Mauskopf*

**196R. Science and Society, 1775-1875.** One course. *Mauskopf*

**195S-196S. Processes of Development in Modern Japan, 1800 to the Present.** Two courses. *Stone*

**195T-196T. Problems in the History of Russia Before 1917.** Two courses. *Lerner or Miller*

**195U-196U. Social Conflict and Political Change in the United States, 1789-1860.** Two courses. *Nathans*

**195V-196V. Problems in Afro-American History.** (Also listed as Black Studies 195-196.) Two courses. *Gavins*

**195W. Studies in Modern Indian History.** One course. *Calkins*

**196W. Pre-Modern Imperial Systems.** Compares components of the political, social, and economic structures of pre-modern bureaucratic empires, stressing seventeenth and eighteenth century India, China, and Iran. One course. *Calkins*

**195X-196X. Problems in Latin American History.** Two courses. *Bergquist or TePaske*

**195Y-196Y. Issues in the History of Tropical Africa.** Two courses. *Hartwig*

**195Z-196Z. Problems in Recent United States Diplomatic History.** Two courses. *Davis*

**197S-198S. Senior Honors Seminar.** A course designed to introduce qualified students to advanced methods of historical research and writing and to the appraisal of critical historical issues. Open only to seniors, but not restricted to candidates for graduation with distinction. This course, when taken by a history major, is accompanied by two courses of 195-196 seminars or at the 200 level. In unusual circumstances, with consent of the instructor, coordinator of the Senior Honors Seminar, and Director of Undergraduate Studies, 191-192 may replace the two courses of 195-196 seminars or at the 200 level. Two courses. *Staff*

### Upperclassmen-Graduate Seminars

See History 201S, 202S, 223S, 224S, 231S, 232S, 237S, 238S, 255S, 256S, 257S, 258S, 265S, 266S, 267S, 268S, 275S, 276S, 277S, 278S, 279S, 297S, and 298S.

### DEPARTMENTAL MAJOR

*Prerequisite.* A year sequence of two prerequisite courses in history (21-22, 21S-22S, 53-54, 91-92, 175D-176D), beginning either semester.

*Major Requirements.* Students desiring to take a major in history elect, in addition to the two prerequisite courses, six courses in the department, including two courses in an undergraduate seminar (195-196, 197S-198S) or on the 200 level. They are urged to register for two consecutive courses at this level, but may take two single semester courses with consent of both instructors. Students wishing to take advanced courses in the history of the United States are advised to elect History 91-92.

**Foreign Languages.** Majors interested in a particular area of study would benefit from knowledge of the language of that area. Majors who contemplate graduate work are reminded of the requirement of a reading knowledge of one or two foreign languages.

**Majors Planning to Teach.** Majors who plan to teach in secondary schools should consult the Education Department. Rising juniors who intend to practice teach in the senior year should take their 195-196 or 197S-198S seminar or 200-level courses as juniors. Two courses, History 229 in the fall and 212 in the spring, are scheduled in accelerated sessions to fit the half semester the student is on campus during the semester he does practice teaching.

**Ancient History.** For additional courses in ancient history which may be taken for credit in history, see the history courses listed in the Department of Classical Studies.

**Honors.** Any student who is qualified (see the section on Honors in this *Bulletin*) may undertake work leading to a degree with distinction in history by applying to the history faculty adviser as a candidate. Usually, honors work involves participation in one of the 195-196 seminars during the junior year and

selection for the Senior Honors Seminar in the senior year. Further information is available at the History Department offices, 236 Allen or 102 West Duke Building.

## House Courses

See page 34 for information on House Courses.

## Interdisciplinary Courses

The following are cooperative courses offered by the departments concerned. Where a department accepts the course for the major, the same number is used as a departmental offering.

**101, 102. Introduction to the Civilizations of Southern Asia.** Hindi, Islamic, and Buddhist foundations, impact of the West, and emergence of the modern nation-states of Southern Asia. First semester: traditional Hindi civilization and Islamic Impact on Southern Asia. Second semester: Western influence and the development of modern societies and states in Southern Asia. (See Departments of Anthropology, History, Political Science, and Religion.) Two courses. *Apte, Braibanti, Calkins, Di Bona, Fox, and Lawrence*

**104. Man and the Marine Environment.** For description see Marine Sciences. One course. *Staff*

**153S. The Insurgent South.** Reconstruction, Populism, and the civil rights era, each approached from a multidisciplinary perspective. Not open to students who have taken Interdisciplinary Courses 199 or History 199. Prerequisite: consent of instructor. (Also listed as History 153S.) One course. *Goodwyn*

**156. The Contemporary Woman: History and Prospects.** A survey of the status of women with consideration of cultural, sociological, psychological, and political aspects. (Also listed as Sociology 156.) Half course. *Friedel, A. Scott, and J. O'Barr*

**158. Women and Literature.** Modern women authors including Virginia Woolf, Doris Lessing, and Anais Nin; myths of women in literature and society. Nature of course adapted to the interests of students. This course may be used for distributional requirements in humanities. Prerequisite: consent of instructor. One course. *Mowrey*

**184. Canada: Problems and Issues of an Advanced Industrial Society.** Federal-provincial relations, economic development, environmental and resource problems, American economic and cultural influences, bilingualism and biculturalism, international relations and aid, defense, military relations with the United States, and the "quest for identity." Some seminars, conducted by visiting Canadian specialists. (See Departments of History, Economics, Political Science, and Sociology.) One course. *Preston and Visiting Lecturers*

**257S, 258S. Modern East Asia: Introduction to Problems and Literature.** Response of the monarchy to the Western challenge; the Western impact and strains in Chinese society; the disintegrative role of the military in modern China; bureaucracy in modern Japan; the role of women in Japanese society; the potential political impact of the Japanese environmental movement; the Korean student revolution; and response to Western pressure. (Also listed as History 257S, 258S and Political Science 257S, 258S.) Two courses. *Dirlik, McKean and Stone*



## Italian

For courses offered in Italian, see *Romance Languages*.

## Judaic Studies—Cooperative Program at Duke and UNC-Chapel Hill

Assistant Professor Bland (Religion), *Acting Director*; Associate Professors Bailey (Divinity), Meyers and Wintermute (Religion); Assistant Professor Alt (Germanic Languages and Literatures)

A program in Judaic Studies may be taken as part of a major in religion, as a supplement to any other major, or under Program II.

For a description of the following courses consult the listings under the specified departments.

### German

Y171. Yiddish Literature in Translation. *Alt*

Y181-182. Yiddish. *Alt*

### Religion

50. The Old Testament. *Staff*

104. The Prophets of the Old Testament. *Wintermute*

105. Theology of the Old Testament. *Wintermute*

131D. Principles of Archeological Investigation. *Meyers*

132D. Palestine in Late Antiquity. *Meyers*

133. Foundations of Post-Biblical Judaism. *Meyers*

134. Jewish Mysticism. *Bland*

135. Jewish Religious Thought. *Bland*

136. Contemporary Jewish Thought. *Meyers*

137. Jewish Ritual and Theology. *Bland*

139. Modern Hebrew. *Staff*

195C, 196C. Junior-Senior Seminars: Judaic Studies. *Staff*

115-116. (Divinity School) Introduction to Biblical Hebrew. *Bailey*

207, 208. (Divinity School) Second Hebrew. *Staff*

220. Third Hebrew. *Staff*

221. Readings in Hebrew Biblical Commentaries. *Bland*

238. Jewish Responses to Christianity. *Bland*

244. The Archeology of Palestine in Hellenistic-Roman Times. *Meyers*

Opportunities for independent study are offered in the Department of Religion under 191, 192, 193, 194. Procedures for registration and application are available in 118 Gray Building.

Special attention is directed to those courses in New Testament which are relevant to the study of Rabbinic Judaism, i.e., Religion 106, 107, 108, 111, and 145 and to the appropriate courses at the University of North Carolina at Chapel Hill.

## Latin

For courses offered in Latin, see *Classical Studies*.

## Linguistics

Students interested in the study of language as part of their undergraduate

program or as preparation for graduate work in linguistics should consult the instructors of the course listed below. No major is offered in linguistics. The courses may be taken as electives by advanced students, and certain courses serve as related work in several major programs. The following courses are described in the listings of the specified departments:

### **Anthropology**

107. Introduction to Linguistics. (Also listed as English 107.) *Apte, Butters, Casson, or Hull*

116. Language, Ethnicity, and New Nations. *Apte*

117. Language, Law, and Politics. *O'Barr*

119. Language, Culture, and Society. *Apte, Casson, or Rosen*

210. Linguistic Anthropology: Theory. *Apte or Casson*

211. Linguistic Anthropology: Ethnography of Communication. *Apte or Casson*

259. Linguistic Anthropology: Language Acquisition. *Casson*

### **English**

107. Introduction to Linguistics. (Also listed as Anthropology 107.) *Apte Butters, Casson, or Hull*

108. Development of the English Language. *Butters*

109. Modern English Grammar. *Butters*

207. Old English Grammar and Readings. *Nygard or Reiss*

208. History of the English Language. *Nygard or Reiss*

209. Present-Day English. *Butters, Nygard or Reiss*

### **French**

210. The Structure of French. *Hull*

219. Old French Literature. *Vincent*

224. History of the French Language. *Hull*

### **German**

205, 206. Middle High German. *Staff*

216. History of the German Language. *Staff*

219. Applied Linguistics. *Staff*

### **Philosophy**

103. Symbolic Logic. *Ross*

109. Philosophy of Language. *Welsh*

### **Spanish**

257. Old Spanish Language. *Davis or Garci-Gómez*

### **Yiddish**

181, 182. Elementary Yiddish. *Alt*

## **Management Sciences**

Professor Keller, *Chairman*; Professor Dickens, *Director of Undergraduate Studies*; Professors Baligh, Cohen, Joerg, Lewin, and Peterson; Adjunct Professor Porter; Associate Professors Abdel-Khalik, Baker, Battle, Burton, Dellinger, and Morse; Assistant Professors Aldrich, Damon, Espejo, Kuhn, Magat, Maier, Scheiner, Taylor, Vander Weide, Westbrook, and Zalkind; Visiting Assistant Professor Rockness

The courses offered by the Department of Management Sciences stress conceptual understanding of, and analytical reasoning related to, problems of modern management, and the relationship between the performance of complex organizations and the society in which they operate.

**50. Elementary Theory of Economic Enterprise.** Analysis of the internal resource allocation of the firm, market structures, and capital theory and the mathematical foundations for this analysis. Prerequisite: Mathematics 31. Not open to students who have taken Economics 2 or 52, except with consent of the Director of Undergraduate Studies. One course.

**50P. Preceptorial.** Elective preceptorial for students enrolled in Management Sciences 50. *Staff*

**70. Analysis of Organizational Behavior.** The structure and behavior of organizations, with special reference to business firms. Topics include rationality, authority, bureaucracy; power, decision-making, informal organization, organization change; effects of technology, culture, and other environmental influences. Corequisite: Management Sciences 50. One course.

**70P. Preceptorial.** Elective preceptorial for students enrolled in management Sciences 70. *Staff*

**90. Introduction to Financial Accounting.** Conceptual framework of external reporting, focusing on the nature and purpose of accounting, the measurement of status and activity in economic terms and the interpretation of published financial statements. Prerequisite: sophomore standing. Students may not receive credit for both Management Sciences 90 and 131. One course.

**110. Probability and Statistics.** Probability theory and distributions. Classical statistical analysis and its application to decision problems. Estimation, hypothesis testing, regression and correlation analysis. Not open to students who have taken public Policy Studies 112, Economics 138, Mathematics 53, or Engineering 150. Prerequisite: Mathematics 31. Corequisite: Management Science 50. One course.

**114. Decision Models.** Mathematical models in the analysis of decision problems. Topics include linear algebra, linear programming, and decision analysis; approaches to the solution of complex problems. Prerequisites: Management Science 50, 70, and 110 and computer programming ability. One course.

**116. Stochastic Operations Research Models.** Topics include inventory theory, queueing theory, stochastic processes, Markov chains, reliability, advanced decision analysis, and simulation. Prerequisite: Management Science 114 or consent of instructor. One course.

**117. Deterministic Operations Research Models.** Topics include decomposition, non-linear programming, integer programming networks, dynamic programming, game theory. Prerequisite: Management Science 114 or consent of instructor. One course.

**121. Leadership and Small Groups.** Normative studies of work group formation, and maturation, and sanctions. Experiential exercises in leadership and group processes. Prerequisite: Management Science 50, 70, and 110 or equivalent. Not open to students who have taken Psychology 147S. One course.

**131. Introduction to Accounting Information Systems.** The accounting model of the firm and transactions analysis. Topics include the procedures used to process accounting data, issues in asset valuation and income determination,

and financial statement analyses. Prerequisite: Mathematics 31 and computer programming ability. Corequisite: Management Science 50. Students may not receive credit for both Management Science 90 and 131. One course.

**131P. Preceptorial.** Elective preceptorial for students enrolled in Management Science 131.

**137. Managerial Accounting.** The use of accounting information by management in short-term planning, control, and decision-making in business enterprises. Cost accumulation, cost analysis, cost estimation, the development of standards, introduction to budgeting, and short run decisions. Prerequisite: Management Science 131; Corequisite: Management Science 114. One course.

**141. Legal Environment of the Firm.** The legal environment of business with particular emphasis on the Uniform Commercial Code. Prerequisite: junior standing. One course.

**145. Federal Income Taxation.** Principles of federal income tax laws related to corporations and individuals. Tax planning and the effect of tax law on business decisions will be emphasized. Prerequisite: Management Science 90 or 131. One course.

**151. Investment Management.** Problems of selecting a portfolio of investments emphasizing the economics of the markets and the tools of analysis. Prerequisite: Management Science 50 and 110 or equivalents, or consent of instructor. One course.

**154. Finance.** Problems of financial management of the firm. Cash management, receivables management, short-term financial planning, cost of capital, capital budgeting, dividend policy, lease analysis and long-term financial planning. Prerequisites: Management Science 131 or 90, and 114 or equivalent. One course.

**161. Marketing Management.** The role of the marketing function in business; product planning, price promotion, and distribution as elements of a total marketing mix. Formal models in solving the firm's marketing mix problem. Prerequisite: Management Science 114. One course.

**171. Production.** An economic and social analysis of designing a production system for an organization, of operating within the designed constraints, and of interactions within the organization and with society. Prerequisite: Management Science 114 and 131. One course.

**191, 192. Independent Study.** Directed reading and research. Approval of the instructor and the Director of Undergraduate Studies required.

**193, 194. Independent Study.** Same as 191, 192 but for seniors.

**201S. Market Structure and Performance.** Industrial conduct and performance under various market structures, both in theory and in practice. Evaluation of public policy measures, such as public utility regulation and antitrust action, which are used to improve market performance. Prerequisite: Management Science 50 and 110 or consent of instructor. Not open to students who have taken Economics 189 or Economics 198. One course.

**202S. Intermediate Theory of Economic Enterprise.** Competitive market strategies and cooperating decisions, analysis of the efficiency and equilibrium of market structures. Emphasizes the interrelationships of the economic environment and the decision of the enterprise. Prerequisite: Management Science 114. One course.



**212S. Seminar in Operations Research.** Topics may include applied operation research, decomposition models of the firm, network analysis, inventory theory, sequencing, or game theory. Prerequisite: Management Science 116 and 117 or consent of instructor. One course.

**220S. Administrative Behavior and Organization Design.** Implications of organization structure for the administrator. Various strategies of decomposition of the firm and the interaction of the structural, technical, and social systems. Dysfunctional properties of structure constraining administrative behavior and organizational effectiveness. Prerequisite: Management Science 161 or 171. One course.

**231. Intermediate Financial Accounting.** Requirements of investors, auditors, unions, and governments for information about the status of operations of firms and a framework for disclosure of the relevant data. Prerequisite: Management Science 131. One course.

**232. Internal Control and Auditing.** The independent auditor's examination of the accounting control system and other evidence as a basis for expressing an opinion on a client's financial statements. Basic audit objectives, standards, ethics, terminology, procedures, and reports. Prerequisites: Management Science 137, 231. One course.

**234. Advanced Financial Accounting.** Accounting for and reporting on the diverse activity of multi-product, multi-divisional, multi-national organizations. Organizations with and without profit goals are studies. Prerequisite: Management Science 137, 231. One course.

**236S. Selected Topics in Financial Accounting.** Interrelationships between selected topics and issues in accounting and other disciplines. Prerequisites: Management Science 137, 231. One course.

**237S. Advanced Managerial Accounting.** Evaluating performance in complex organizations. Transfer pricing, inventory systems, the use of linear programming in developing budgets and capital budgeting. Some aspects of the behavioral consequences of performance measurements. Prerequisite: Management Science 137, 231. One course.

**251S. Seminar in Managerial Finance.** Topics to be arranged. Prerequisite: Management Science 151. One course.

**261S. Seminar in Marketing.** Topics to be arranged. Prerequisite: Management Science 161 or consent of instructor. One course.

**271S. Seminar in Production.** Topics to be arranged. Prerequisite: Management 171. One course.

## DEPARTMENTAL MAJOR

The Department of Management Science offers two majors: Management Science and Management Science/Accounting. Each major requires at least seven courses in Management Sciences including the core program.

*Core Program:* Mathematics 31, Management Sciences 50, 70, 110, 114 and computer programming competence. Recommended: a course in macroeconomics.

*Required Courses—Management Sciences Major:* Four courses in addition to the core, other than Management Sciences 90, offered by the department, three of which must be number 116, 117 or be numbered 154 or above. One of the following economics courses may count for credit in the Management Sciences major: 139, 153, 154, 155, 243, 244.

*Required Courses—Management Science/Accounting Major:* Management Sciences 131 in addition to the core, and three additional courses from the 130, 230 series.

A student may specialize in public or industrial accounting in his junior and senior years. The following sequence of courses is recommended as preparation for certification as a professional accountant:

*Freshman Year*

Mathematics 31, Introductory Mathematical Analysis  
Management Sciences 50, Elementary Theory of Economic Enterprise  
Computer Science 51 or development of competence in computer operations

*Sophomore Year*

Management Sciences 70, Analysis of Organizational Behavior  
Management Sciences 110, Probability and Statistics  
Management Sciences 114, Decision Models  
Management Sciences 131, Introduction to Accounting Information Systems

*Junior Year*

Management Sciences 137, Managerial Accounting  
Management Sciences 141, Legal Environment of the Firm  
Management Sciences 145, Federal Income Taxation  
Management Sciences 231, Intermediate Financial Accounting

*Senior Year*

Management Sciences 232, Internal Control and Auditing  
Management Sciences 234, Advanced Financial Accounting  
Management Sciences 236S, Selected Topics in Accounting  
Management Sciences 237S, Advanced Managerial Accounting

## Marine Sciences—The University Program

Professor Costlow, *Director*; Professors Bookhout (Zoology), Johnson\* (Botany) and Pilkey\* (Geology); Associate Professors Barber (Botany and Zoology), Gutknecht (Physiology), Searles\* (Botany), and Sutherland (Zoology); Assistant Professors Baier (Chemistry), Blankley (Botany), Forward (Zoology), and Sullivan (Biochemistry); Associate J. Bonaventura (Biochemistry); Research Associate C. Bonaventura (Biochemistry)

The interdisciplinary program in the marine sciences makes it possible for qualified juniors and seniors to live and study at the Duke University Marine Laboratory, Beaufort, North Carolina, during the spring semester. The program consists of two courses (104 and 150, 169 or 220) and one seminar, in addition to independent research. A student may continue study at the Marine Laboratory during the summer either by participating in advanced courses or by continuing independent studies initiated during the spring term.

Applications are to be submitted by October 7 to the Director, Duke University Marine Laboratory, Beaufort, North Carolina 28516, and should include two letters of recommendation, one of which must be from the director of undergraduate studies of the student's major department. A current transcript is also required. Students will be notified of the action of the review committee prior to registration for the spring semester.

### SPRING COURSES AT BEAUFORT

**Man and the Marine Environment.** (Interdisciplinary Course 104.) Economic, legal, medical, political, social, and scientific viewpoints on the effect of society on the marine environment; special emphasis on coastal North Carolina. Lectures and laboratories. One course. *Costlow and Staff*

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\*In residence during summer only.

**Physiology of Marine Animals.** (Zoology 150L.) Comparative physiology including special ecological and behavioral adaptations. Students may not receive credit for both Zoology 150L and 250L. Prerequisites: introductory biology and Chemistry 12. One course. *Forward*

**The Marine Environment.** (Botany 169L, Geology 169, and Zoology 169L.) Interrelationships of the geological, chemical, and biological aspects of the estuarine and oceanic environments. Lectures and laboratories. Prerequisite: Chemistry 12. One course. *Sutherland*

**Independent Study.** (Botany 192, Geology 192, and Zoology 192.) For junior and senior majors with consent of the Director of Undergraduate Studies and the supervising instructor. One and one half courses. *Staff*

**Adaptations of Organisms to the Marine Environment.** (Biochemistry 220.) Introduction to basic concepts of biochemistry and to variables in the marine environment which evoke adaptive responses. Specific adaptations at the molecular level and biological fitness from a biochemical viewpoint. Laboratory experiments utilize many basic methods of biochemical analysis. Prerequisites: basic biology and chemistry and consent of instructor. One course. *C. Bonaventura and J. Bonaventura*

**Seminar.** (Botany 296S and Zoology 296S.) Topics, instructors, and course credits announced each semester. *Staff*

## SUMMER COURSES AT BEAUFORT

The following courses are described in the listings of the specified departments or the *Bulletin of the Duke University Marine Laboratory*.

**Introduction to Biological Oceanography.** (Zoology 114L.) One and one half courses. *Cox (Visiting Summer Faculty)*

**Phytoplankton Systematics.** (Botany 202L.) One and one half courses. *Blankley*

**Introduction to Comparative Behavior.** (Zoology 202L.) One and one half courses. *Salmon (Visiting Summer Faculty)*

**Marine Ecology.** (Zoology 203L.) One and one half courses. *Sutherland*

**Marine Microbiology.** (Botany 204L.) One and one half courses. *Blankley*

**Geological Oceanography.** (Geology 205.) One and one half courses. *Pilkey*

**Marine Phycology.** (Botany 211L.) One and one half courses. *Searles*

**Marine Membrane Physiology.** (Physiology 212.) One and one half courses. *Gutknecht and Staff*

**Biological Oceanography.** (Botany 214L and Zoology 214L.) One and one half courses. *Barber*

**Chemical Pollution of Coastal Waters.** (Chemistry 230.) One and one half courses. *Baier*

**Chemical Oceanography.** (Chemistry 240.) One and one half courses. *Baier*

**Physiological Ecology of Marine Animals.** (Zoology 250L.) One and one half courses. *Forward*

**Marine Invertebrate Zoology.** (Zoology 274L.) One and one half courses. *Barnes (Visiting Summer Faculty)*

**Comparative and Evolutionary Biochemistry.** (Biochemistry 276.) One and one half courses. *Sullivan*

**Invertebrate Embryology.** (Zoology 278L.) One and one half courses. *Bookhout*

## Mathematics

Professor Warner, *Chairman*; Professor Murray, *Director of Undergraduate Studies*; Assistant Professor L. Smith, *Supervisor of Freshman Instruction*; Professors Allard, Carlitz, Reed, Shoenfield, and Weisfeld; Associate Professors Burdick, R. Hodel, Kitchen, D. Kraines, Moore, Scoville, D. Smith, and Stackelberg; Visiting Associate Professor Gut; Adjunct Associate Professor Chandra; Assistant Professors Butler, Cantor, Katz, Lees, Mackichan, and Protter; Instructors Lawrence and Williams; Part-time Instructors M. Hodel and V. Kraines

**19. Pre-Calculus Mathematics.** Selected topics in algebra, trigonometry, and analytic geometry. Students with CEEB achievement scores in mathematics below 530 need this skill course before taking Mathematics 31. Prerequisite: two units of college preparatory mathematics. One course. *Staff*

**31, 32. Introductory Calculus.** Limits, differentiation, integration, elementary and transcendental functions, sequences, series, Taylor's formula. Prerequisite: three years of college preparatory mathematics. Mathematics 31 is prerequisite to Mathematics 32. Two courses. *Staff*

**31P, 32P. Preceptorial.** Elective preceptorial for students enrolled in Mathematics 31, 32. *Staff*

**31X, 32X. Honors Calculus.** Similar to Mathematics 31, 32, but more theoretical. Majors in mathematics as well as others who have achievement scores of 760-800 are encouraged to enroll. Occasionally these courses will be offered as seminars. Two courses. *Staff*

**33, 34. Introductory Calculus with Digital Computation.** Introduction to the digital computer, analytical and numerical treatments of limits, differentiation, integration, solution of equations in one variable, elementary transcendental functions, sequences, series, Taylor's formula, applications. Mathematics 33 is prerequisite to Mathematics 34. Two courses. *Staff*

**53. Basic Statistics.** Statistical concepts involved in making inferences, decisions, and predictions from data. Techniques not emphasized. Not open to students who have had Economics 138 or Psychology 117. One course. *Staff*

**103. Intermediate Calculus.** Solid analytic geometry with vectors, partial differentiation, multiple integrals, elementary differential equations, and complex numbers. Prerequisite: Mathematics 32 or 34. One course. *Staff*

**103P. Preceptorial.** Optional preceptorial for students enrolled in Mathematics 103. *Staff*

**104. Linear Algebra and Applications.** Euclidean  $n$ -space, abstract vector spaces, linear transformations and matrix representation, elementary row operations, determinants, eigenvectors and eigenvalues; and applications to the solution of ill-conditioned simultaneous systems. Prerequisite: Mathematics 32 or 34. One course. *Staff*

**104P. Preceptorial.** Optional preceptorial for students enrolled in Mathematics 104. *Staff*

**103x, 104X. Sophomore Honors Calculus.** Similar to Mathematics 103, 104,



but more theoretical. Students who take 31X, 32X are encouraged to enroll. Students continuing from 103X should take 104X rather than 104. Two courses. *Staff*

**111. Applied Mathematical Analysis I.** Ordinary differential equations, including linear differential equations of order  $n$ ; partial linear differential equations with constant coefficients; topics in vector calculus; Fourier series. Not open to students who have had Mathematics 131. Prerequisite: Mathematics 103. One course. *Staff*

**112. Applied Mathematical Analysis II.** Complex variables, residues, conformal mapping, matrices, Laplace and Fourier Transforms and their applications. Prerequisite: Mathematics 103. One course. *Staff*

**126. Introduction to Linear Programming and Game Theory.** Fundamental properties of linear programs; linear inequalities and convex sets; primal simplex method, duality; integer programming; two person and matrix games. Prerequisites: Mathematics 32 or 34 and 103 and 104 or consent of instructor. One course. *Weisfeld*

**128. Number Theory.** Divisibility properties of integers; prime numbers; congruences; quadratic reciprocity; number-theoretic functions; simple continued fractions; rational approximations. Prerequisite: Mathematics 32 or 34 or consent of the instructor. One course. *Staff*

**129. Introduction to Modern Algebra.** Elementary theory of groups, rings, and fields; construction of basic number systems. Prerequisite: Mathematics 104. One course. *Staff*

**131. Elementary Differential Equations.** Solution of differential equations of elementary types; formation and integration of equations arising in applications. Not open to students who have had Mathematics 111. Prerequisite: Mathematics 103. One course. *Staff*

**132S. Qualitative Theory of Ordinary Differential Equations.** Qualitative behavior of general systems of ordinary differential equations, with application to biological and ecological systems, oscillations in biochemistry, electrical networks, and the theory of deterministic epidemics. Prerequisite: Mathematics 131 or 111 or consent of the instructor. One course. *Cantor*

**135, 136. Probability and Statistics.** Permutations and combinations, total and compound probability, Bayes' formula, Bernoulli's theorem, discrete distributions, central values, moments and mathematical expectation, law of large numbers, probabilities in continuum, continuous distributions, sampling distributions, confidence limits, tests of hypotheses, and analysis of variance. Prerequisites: Mathematics 103 for 135; 135 and 104 for 136. Two courses. *Burdick*

**135P, 136P. Preceptorial.** Optional preceptorials for students enrolled in Mathematics 135, 136. *Burdick*

**139, 140. Advanced Calculus.** Differential and integral calculus of functions of several variables; spaces of continuous functions; Fourier series; existence theorems and uniqueness theorems for differential equations; line and surface integrals; Green's theorem and Stokes' theorem; power series and analytic functions. Prerequisites: Mathematics 103 and 104 for 139; 139 for 140. Two courses. *Staff*

**152. List Processing and Data Structures.** (Also listed as Computer Science 152.) One course. *Staff*

**161. Numerical Solution of Ordinary Differential Equations.** Basic exist-

ence and uniqueness considerations; algorithmic procedures for step-by-step integration; stability theory and its limitations; accuracy analysis and numerical procedures for determining it; analogue methods and their accuracy and stability characteristics. Prerequisites: Mathematics 103 and 104. One course. *Murray*

**171S. Elementary Topology.** Basic set theory; metric spaces; topological spaces; continuity; basic topological properties including compactness and connectedness. Prerequisite: Mathematics 103 and 104. One course. *Staff*

**181. Complex Analysis.** Complex numbers, analytic functions, complex integration, Cauchy's theorem, Taylor and Laurent series, theory of residues, argument and maximum principles, conformal mapping. Prerequisite: Mathematics 103 and 104. One course. *Staff*

**183. Introduction to Statistical Methods.** Emphasis on the classical techniques of hypothesis testing and point and interval estimation, using the binomial normal,  $t$ ,  $F$ , and chi square distributions. Prerequisite: Mathematics 32 or 34 or consent of the instructor. One course. *Staff*

**187. Introduction to Mathematical Logic.** Propositional calculus, predicate calculus. Godel completeness theorem, applications to formal number theory, incompleteness theorem, additional topics in proof theory or computability. Prerequisites: Mathematics 103 and 104 or Philosophy 103. One course. *Staff*

**191, 192. Independent Study.** Directed reading and research. Admission by approval of instructor and Director of Undergraduate Studies. Two courses. *Staff*

**193, 194. Independent Study.** Same as 191, 192, but for seniors. Two courses. *Staff*

**196S. Seminar in Mathematical Model Building.** Real models, mathematical models, axiom systems as used in model building, deterministic and stochastic models, linear optimization, competition, graphs and networks, growth processes, evaluation of models. Term project: model of a nonmathematical problem. Prerequisite: Mathematics 103 and 104. One course. *D. Smith*

**197S. Seminar in Mathematics.** Primarily intended for juniors and seniors majoring in mathematics. Content of course determined by instructor. Prerequisite: Mathematics 103 and 104. One course. *Staff*

## For Seniors and Graduates

**204. Geometry for Teachers.** Metric and synthetic approaches to plane and solid geometry; affine geometry, and an algebraic model of Euclidean geometry. One course. (3 graduate units.) *Staff*

**206. Introduction to Stochastic Processes.** Elementary theory and application of stochastic process models; Poisson processes, counting processes, discrete parameter Markov chains. Prerequisite: Mathematics 135. One course. (3 graduate units.) *Staff*

**207, 208. Introduction to Algebraic Structures.** Groups, rings, fields; isomorphism theorems; partial and total orderings; characterizations of basic number systems; permutation groups; finitely generated Abelian groups; polynomial rings; principal ideal domains; division and Euclidean algorithms; vector spaces; linear transformations and matrices; bilinear forms; multilinear algebra; determinants; finite dimensional inner product spaces. Prerequisites: Mathematics 103 and 104 for 207; and 207 for 208. Two courses. (6 graduate units.) *Warner*

**217, 218. Intermediate Analysis.** Elementary point set topology and differential calculus in  $n$ -space; implicit and inverse function theorems; integration theory; differentiable manifolds; differential forms; generalized Stokes' theorem. Prerequisite: Mathematics 103 and 104 for 217; and 217 for 218. Two courses. (6 graduate units.)

**221, 222, 223. Numerical Analysis.** For a description of these courses, see Computer Science 221, 222, 223. Three courses. (9 graduate units.) *Patrick*

**\*227, 228. Theory of Numbers.** Congruences, arithmetic functions, compound moduli, quadratic reciprocity, Gauss sums, quadratic forms, sums of squares. Prerequisites: Mathematics 103 and 104 for 227; and 227 for 228 or equivalent. Two courses. (6 graduate units.) *Staff*

**\*229, 230. Algebraic Numbers.** Ideals, unique factorization, divisors of the discriminant, determination of the class number. Prerequisites: Mathematics 207 for 229; and 229 for 230. Two courses. (6 graduate units.) *Carlitz*

**231. Applications of Graph Theory.** Linear graphs, matrix representations, cycle structure, isomorphism, connectivity, independence, planarity, coloring, directed graphs, flows in networks as applied to engineering, management, computer science, urban systems, chemistry, physics, economics, sociology, psychology. Prerequisite: Mathematics 103 and 104 or equivalent. One course. (3 graduate units.) *Staff*

**\*234. Sample Designs.** Methods of constructing and analyzing survey designs; elements of simple random sampling, stratified sampling, multistage sampling; methods of estimation; questionnaire construction; refusal and non-at-homes. Prerequisite: Mathematics 183. One course. (3 graduate units.) *Staff*

**235, 236. Algebra.** Elementary categorical algebra; groups with operators,  $G$ -sets structure groups; commutative algebra; principal ring modules; structure of rings and modules; field theory. Prerequisites: Mathematics 208 or equivalent for 235; and 235 for 236. Two courses. (6 graduate units.) *Staff*

**244. Analysis of Variance.** Multiple regression, univariate and multivariate ANOVA, multiple comparisons (Scheffe, Tukey, etc.), factorial designs, analysis of covariance, repeated measurement designs. Prerequisite: Mathematics 183 or equivalent. One course. (3 graduate units.) *Staff*

**\*245, 246. Combinational Analysis.** Generating functions, permutations, distributions, partitions, compositions, trees, and networks. Prerequisite: calculus. Two courses. (6 graduate units.) *Carlitz*

**\*247, 248. Arithmetic of Polynomials.** Field theory, detailed study of finite fields, special polynomials and functions, valuation theory, the zeta function. Prerequisites: Mathematics 207 or consent of instructor for 247; and 247 for 248. Two courses. (6 graduate units.) *Carlitz*

**256. Orientation for Applied Mathematics.** Simulation and related notions; relation of science and technology with evolution of mathematics; modern generalizations of the concepts of language, validity, empirical science, and statistical inference. Areas of application for various specific mathematical topics. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Murray*

**260. Design of Experiments.** Factorial and fractional factorial designs, confounding, balanced and partially balanced block designs, response surface

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\*Offered on demand.



methodology, method of steepest ascent, comparison of criteria for optimality of design. Prerequisite: Mathematics 136. One course. (3 graduate units.) *Burdick*

**\*262. Non-Parametric Statistics.** A study of statistical tests in which no assumption about the underlying distribution is made; single and multiple sample tests for nominal and ordinal scales; non-parametric measures of correlation, efficiency of tests. Prerequisite: Mathematics 136 or consent of instructor. One course. (3 graduate units.) *Staff*

**265, 266. Homological Algebra and its Applications.** Categorical algebra; derived categories and homology; sheaves and their cohomology; applications to smooth manifolds and to complex manifolds; preschemes and schemes and their local cohomology. Prerequisites: Mathematics 236 and 271 or consent of instructor. Two courses. (6 graduate units.) *Weisfeld*

**268. Mathematical Foundations of General Relativity.** Review of special relativity, the structure of Lorentz manifolds, curvature tensors and geodesics, the momentum-energy tensor and the Einstein field equations, the Schwarzschild solution and gravitational collapse. Prerequisite: Mathematics 104 or 111, and Physics 42, or consent of instructor. (Also listed as Physics 268.) One course. (3 graduate units.) *Cantor*

**269, 270. Recursive Function Theory.** Basic properties, enumeration theorems, hierarchies, recursive functions of higher types, generalized recursion theory; applications. Prerequisite: Mathematics 187 or consent of instructor. Two courses. (6 graduate units.) *Shoenfield*

**271. Point Set Topology.** Basic topological properties, including compactness, connectedness, separation axioms, and countability properties; metric spaces; product and function spaces. Prerequisite: Mathematics 139 or equivalent. One course. (3 graduate units.) *Staff*

**272. Introductory Algebraic Topology.** Fundamental group and covering spaces; homology groups of cell complexes; classification of compact surfaces; the cohomology ring and Poincaré duality for manifolds. Prerequisite: Mathematics 271. One course. (3 graduate units.) *Staff*

**273. Algebraic Topology.** Fibrations, confibrations and Puppe sequences; homology, cohomology and homotopy theories; Hurewicz isomorphisms theorem; Brown representation theorem; generalized cohomology theories. Prerequisite: Mathematics 272. One course. (3 graduate units.) *Staff*

**274. Geometric Topology.** Handle decomposition of manifolds, isotopy extension theorem; geometric and algebraic intersection numbers; Whitehead torsion and the s cobordism theorem. Prerequisite: Mathematics 272. One course. (3 graduate units.) *Staff*

**275, 276. Probability.** Foundations of probability; random variables; distributions; central limit problem; law of large numbers; limit and ergodic theorems. Prerequisites: Mathematics 291 or consent of instructor. Two courses. (6 graduate units.) *Staff*

**284. Least Squares Analysis of Linear Models.** General linear models; geometrical interpretations; multiple regression; one-way and multi-way analysis of variance; fixed, random, and mixed models; experimental design models; analysis of covariance; introduction to nonlinear models. Prerequisite: Mathematics 136. One course. (3 graduate units.) *Burdick*

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\*Offered on demand.



**285. Applied Mathematical Methods I.** Heat equation, wave equation, separation of variables, Fourier series, introduction to Hilbert space, Fourier transform, potential theory; complex variables, residues. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Reed*

**286. Applied Mathematical Methods II.** Eigenvalue problems, integral equations, Fredholm alternative, bounded linear transformations on Hilbert space, applications to partial differential equations, techniques for approximating eigenvalues. Prerequisite: Mathematics 103 and 104. One course. (3 graduate units.) *Reed*

**\*287, 288. Foundations of Mathematics.** Propositional calculus, predicate calculus, axiomatized number theory. Godel completeness and incompleteness theorems. Recursive functions; hierarchies; constructive ordinals. Set theory; consistency of the axiom of choice. Prerequisite: Mathematics 208 or Philosophy 103, or consent of instructor. (Also listed as Philosophy 287, 288.) Two courses. (6 graduate units.) *Shoenfield*

**290. Stochastic Processes.** Foundations and probabilistic structure of stochastic processes; sample function properties, processes with finite second-order moments, stationary processes; representations. Prerequisite: Mathematics 275. One course. (3 graduate units.) *Staff*

**291, 292. Analysis I, II.** Measure and integration theory; introduction to functional analysis; theory of analytic functions. Prerequisite: Mathematics 218 or 140, or consent of instructor. Two courses. (6 graduate units.) *Staff*

**293. Multivariate Statistics.** Basic multinormal distribution theory, the multivariate general linear model including the use of Hotelling's  $T^2$  statistic and the Roy union-intersection principle, principal components, canonical analysis, and factor analysis. Prerequisite: Mathematics 284 or consent of instructor. One course. (3 graduate units.)

**\*295. Mathematical Foundations of Statistical Inference.** Inference-theoretic approach to hypothesis testing, decision making, and estimation; Neyman-Pearson fundamental lemma; uniformly most powerful tests; Fisher's information and sufficiency; invariance and unbiasedness. Prerequisite: Mathematics 275 or consent of the instructor. One course. (3 graduate units.) *Staff*

**297, 298. Axiomatic Set Theory.** Statement and development of Zermelo-Fraenkel axioms. Consistency and independence problems. New axioms and their consequences. Prerequisite: consent of instructor. Two courses. (6 graduate units.) *Shoenfield*

## DEPARTMENTAL MAJOR

*Prerequisites.* Mathematics 31, 32.

*Major Requirements.* Mathematics 103, 104; and six additional courses in mathematics numbered above 100 which must include one of the following year sequences: Mathematics 139, 140; Mathematics 207, 208; or Mathematics 217, 218. Mathematics 183 and 244 may not be counted among the six courses, and at most two of the following four courses may be counted: 152, 221, 222, 223.

It is recommended that majors take a one year sequence in a natural science other than mathematics. For a student considering graduate study in mathematics, a reading knowledge of two foreign languages (often French, German, or Russian) is most desirable.

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\*Offered on demand.

## Medicine, School of—Basic Science Courses Open to Undergraduates

A qualified student in arts and sciences may select courses from the following offered by the graduate departments associated with the School of Medicine. A major is not offered to undergraduates in any of the departments listed below. For permission to register for these courses and for further information, see Assistant Professor Cartmill (Anatomy); Assistant Professor Richardson (Biochemistry); Assistant Professor Vanaman (Microbiology and Immunology); and Associate Professor Padilla (Physiology and Pharmacology). The following courses are described in the *Bulletin of the Graduate School*.

### ANATOMY

**151. Anatomy of the Lower Extremities as it Relates to Locomotion.** One course. *Bassett*

**193, 194. Independent Study.** Open to qualified juniors and seniors with written consent of instructor. Two courses. *Staff*

**212. Cellular Endocrinology.** Prerequisite: Anatomy 307. Minimum, 5. One course. *Fletcher*

**215. Contractile Processes.** Prerequisite: consent of instructor. (Also listed as Physiology 216.) One course. *Anderson, Jöbssis, Johnson, and Reedy*

**231. Human Evolution.** Prerequisite: Anthropology 93 or equivalent. (Also listed as Anthropology 231.) One course. *Cartmill*

**240. Mechanisms of Biological Motility.** Prerequisite: written consent of instructor. One course. *Adelman*

**264. Mammalian Embryology and Developmental Anatomy.** Prerequisites: one year of zoology and consent of instructor. One course. *Duke*

### BIOCHEMISTRY

**209-210. Independent Study.** One or two courses by arrangement. *Staff*

**216. Molecular Genetics.** Prerequisites: introductory courses in biochemistry and genetics. (Also listed under Genetics.) One course. *Guild and Staff*

**220. Adaptations of Organisms to the Marine Environment.** One course. (Given at Beaufort.) *C. Bonaventura and J. Bonaventura*

**248. Introductory Biochemistry.** Prerequisites: Chemistry 151, one year of college physics (second semester may be concurrent), and Mathematics 32, consent of instructors. (Listed also as Botany 248.) One course. *Staff*

**276. Comparative and Evolutionary Biochemistry.** (Also listed under Marine Sciences.) One and one half courses. (Given at Beaufort.) *Sullivan*

**293. Macromolecules.** Prerequisite: Chemistry 161-162 or equivalent. One course. *Hill, Kim, Richardson, and Tanford*

**295. Enzyme Mechanisms.** One course. *Fridovich and Rajagopalan*

**297. Intermediary Metabolism.** One course. *Bell, Greene, Kirshner, and Siegel*

### MICROBIOLOGY AND IMMUNOLOGY

**209-210. Independent Study.** A laboratory or library project. One or two courses by arrangement. *Staff*

**221. Medical Microbiology.** Prerequisite: consent of instructor. One course. *Joklik and Staff*

**221L. Medical Microbiology.** Prerequisite: consent of instructor. One and one half course. *Joklik and Staff*

**233. Microbiology.** (Also listed as Botany 233.) One course. *Burns, Dawson, Joklik, and Willett*

**252. General Animal Virology and Viral Oncology.** Prerequisite: consent of instructor. One course. *Joklik, Nichols, Smith, and Zweerink*

**282. Molecular Microbiology.** Prerequisite: Microbiology 233 or consent of instructor. One course. *Burns, Leis, Nichols and Vanaman*

**291. Basic Immunology.** Prerequisite: consent of instructor. One course. *Scott and Staff*

## PHYSIOLOGY AND PHARMACOLOGY

**204. Introduction to Modern Physiology.** Prerequisites: at least one year of college physics and college biology, calculus, and organic chemistry (physical chemistry is strongly recommended). One course. *Blum and Staff*

**208. Respiratory System in Health and Disease.** Half course. *Kylstra, Saltzman and Salzano*

**212. Marine Membrane Physiology.** (Also listed under Marine Sciences—given at Beaufort.) One and one half courses. *Gutknecht and Staff*

**215. Topics in Developmental Physiology.** Half course. *Lieberman and Mendell*

**216. Contractile Processes.** Prerequisite: consent of instructor. (Also listed as Anatomy 215.) One course. *Anderson, Jöbsis, Johnson, and Reedy*

**217. Membrane Transport.** Half course. *Gunn, Gutknecht, Hall, Kirk, Lauf, Mandel, McManus, and Semon*

**222. Marine Electrobiology.** Prerequisite: consent of instructor. (Given at Beaufort.) One and one half courses. *Wachtel and Wohlbarsht*

**230. Molecular and Cellular Basis of Development.** One course. *Padilla and Staff*

**230S. Seminar.** Optional seminar offered in conjunction with Physiology 230. Half course. *Counce and Staff*

**252. Cellular and Chemical Pharmacology.** One course. *Ottolenghi and Staff*

**254. Mammalian Toxicology.** One course. *Menzel and Staff*

**256. Human Nutrition.** Half course. *Menzel*

## Medieval and Renaissance Studies Program

Professor Mahoney, *Chairman of the Committee on Medieval and Renaissance Studies*

The Program in Medieval and Renaissance Studies, an interdisciplinary major, is designed to provide the student with a well-rounded understanding of the historical, cultural, and social forces that shaped the Medieval and Renaissance periods. The program is divided into four areas of study: fine arts (art and music); history; language and literature (French, German, Greek, Italian, Latin, and Spanish); and philosophy-religion.

A major consists of at least eight courses drawn from the non-introductory courses of the four areas of study, including three courses in each of the two areas. Besides the courses specifically listed (under departmental headings) in the Medieval and Renaissance periods, provision may be made for independent study in any of the four areas. Each student's program is tailored to his or her interests and needs under the supervision of a committee consisting of faculty members from appropriate departments.

After discussions with the Chairman of the Committee on Medieval and Renaissance Studies, the student submits a provisional program of study outlining special interdisciplinary interests. Normally the student should plan the program well before the end of the sophomore year to allow time to acquire a working knowledge of languages pertinent to his interests.

The courses listed below are among those now available for the fulfillment of the major prerequisites and requirements. They are described under the listings of the specified departments.

## DEPARTMENT OF ART

- 133. Medieval Architecture. *Sunderland*
- 134. Medieval Painting and Sculpture. *Sunderland*
- 135, 136. Art of Northern Europe in the Fifteenth and Sixteenth Centuries. *Mueller*
- 137, 138. Italian Renaissance Art. *Jenkins*
- 144. Renaissance and Baroque Architecture. *Sunderland*
- 233. Early Medieval Architecture. *Sunderland*
- 237. French Renaissance Art. *Jenkins*

## DEPARTMENT OF CLASSICAL STUDIES

### Latin

- 87, 88. Sight Reading in Classical, Medieval, and Renaissance Latin. *Staff*
- 221. Medieval Latin I. *Newton*
- 222. Medieval Latin II. *Newton*
- 225. Paleography. *Newton*

### Classical Studies

- 117. Ancient Mythographers. *Newton*

## DEPARTMENT OF ENGLISH

- 112. English Literature of the Middle Ages. *Reiss*
- 113. Chaucer. *DeNeef, Nygard, or Reiss*
- 121. English Literature of the Sixteenth Century. *DeNeef*
- 123, 124. Shakespeare. *DeNeef, Jones, or Williams*
- 125. English Literature of the Early Seventeenth Century. *DeNeef*
- 127. Milton. *DeNeef or Price*
- 129. English Drama from the Middle Ages through the Eighteenth Century. *Clum or Reardon*
- 207, 208. History of the English Language. *Nygard or Reiss*
- 210. Old English Literary Tradition. *Nygard or Reiss*
- 212. Middle English Literary Tradition. *Nygard or Reiss*
- 215. Chaucer. *Nygard or Reiss*
- 216. Chaucer. *Nygard or Reiss*
- 221. English Prose of the Sixteenth Century.
- 222. English Non-Dramatic Poetry of the Sixteenth Century. *DeNeef*



- 223. Spenser. *DeNeef*
- 224. Shakespeare. *Williams*
- 225, 226. Tudor and Stuart Drama, 1500-1642. *Randall*
- 229. English Literature of the Seventeenth Century. *DeNeef, Randall, or Williams*
- 232. Milton.

## DEPARTMENT OF GERMANIC LANGUAGES AND LITERATURE

- 205, 206. Middle High German. *Staff*
- 215S. Seventeenth Century Literature. *Borchardt*
- 216. History of the German Language. *Staff*
- 217S. Renaissance and Reformation Literature. *Borchardt*

## DEPARTMENT OF HISTORY

- 103. The Economic, Social, and Political Institutions of Europe, 1250-1600. *Witt*
- 104. The Intellectual Life of Europe, 1250-1600. *Witt*
- 107. The Social and Cultural History of England. *Ferguson*
- 133. Medieval Europe, 300-1000 A.D. *Young*
- 134. Medieval Europe, 1000-1400 A.D. *Young*
- 154. Medieval England. *Young*
- 173. History of Spain and the Spanish Empire from Late Medieval Times. *TePaske*
- 195A-196A. Renaissance Intellectual History. *Witt*
- 195N-196N. The English Renaissance. *Ferguson*
- 221. Problems in the Economic and Social History of Europe, 1200-1700. *Witt*
- 222. Problems in European Intellectual History, 1250-1550. *Witt*
- 237S. Europe in the Early Middle Ages. *Young*
- 238S. Europe in the High Middle Ages. *Young*
- 267S, 268S. From Medieval to Early Modern England. *Ferguson*

## DEPARTMENT OF MUSIC

- 159S. Music History IV: History of Music to 1600. *Kirkendale and Tirro*
- 166S. The Renaissance Madrigal. *Saville*

## DEPARTMENT OF PHILOSOPHY

- 119. Medieval Philosophy. *Mahoney*
- 120. Late Medieval and Renaissance Philosophy. *Mahoney*
- 218. Medieval Philosophy. *Mahoney*

## DEPARTMENT OF RELIGION

- 121. Christianity in Europe from the Middle Ages to the Protestant Reformation. *Staff*
- 135. Jewish Religious Thought. *Bland*

## DEPARTMENT OF ROMANCE LANGUAGES

### French

- 106S. Montaigne. *Tetel*
- 114. The Sixteenth Century. *Vincent or Tetel*
- 117S. Masterpieces of French Medieval Literature. *Ripley*

- 119. French Drama of the Seventeenth Century. *Staff*
- 213, 214. French Literature of the Seventeenth Century. *Staff*
- 219. Old French Literature. *Vincent*
- 225. French Prose of the Sixteenth Century. *Tetel*
- 226. French Poetry of the Sixteenth Century. *Tetel*

### Italian

- 141. Masterworks of Italian Literature in English Translation. *Caserta*
- 183. Readings in Italian Literature. *Caserta*
- 284. Dante. *Fowlie*
- 285. Dante. *Caserta*
- 288. The Renaissance. *Tetel*

### Spanish

- 117S. Spanish Traditional Poetry. *Garci-Gómez*
- 161. Spanish Literature of the Renaissance and the Baroque. *Miller or Ward-ropper*
- 167. Cervantes: *Don Quixote*. *Predmore*
- 170. The Picaresque Novel. *Garci-Gómez*
- 251. The Origins of Spanish Prose Fiction. *Wardropper*
- 252. Spanish Lyric Poetry Before 1700. *Wardropper*
- 253. The Origins of the Spanish Theater. *Wardropper*
- 257. Old Spanish Language. *Davis*
- 258. Medieval Literature. *Davis or Garci-Gómez*
- 265. Cervantes. *Predmore or Wardropper*
- 266. Drama of the Golden Age. *Wardropper*

### Romance Languages

- 124. Continental Humanism. *Tetel*

## Music

Associate Professor Tirro, *Chairman*; Assistant Professor Henry, *Director of Undergraduate Studies*; Professors Bone, Bryan, Douglass, Hamilton, Hanks, Kirkendale, Mueller, and Withers; Associate Professor Saville; Assistant Professor Maves; Resident Artist Ciompi; Lecturers Lister-Sink and Smith; Staff Associates Erdberg, Evans, Lail, Marcellus, Motylinski, Otto, Parkins, Plumb, Raimi, Redding, Ruggero, Shaw, and Turner; Artist Associates Bergstone, Dunigan, B. Fecteau, R. Fecteau, Henes, Listokin, Popkin, and Robinson; Librarian Hammond

## THEORY AND COMPOSITION

**7-8. Dictation and Sight-Singing.** Techniques of aural analysis and development of sight-reading skills. Music majors should take this course concurrently with Music 65-66. Skill courses. Half course each semester. *Plumb*

**65. Fundamentals of Music Theory.** Physical properties of sound; principles of diatonic tonal organization; melodic and harmonic constructions; elementary counterpoint and figured bass. Skill course. Prerequisite: basic knowledge of musical notation and vocabulary. Music majors should take Music 7 concurrently. One course. *Maves*

**66. Tonal Harmony.** Harmonic language of eighteenth and nineteenth century classicism; functional chromaticism, sectional forms. Music majors should take Music 8 concurrently. Prerequisites: Music 65 and 7. One course. *Maves*

**107-108. Keyboard Theory.** Harmonic principles of tonal music applied to the keyboard; score reading, figured bass, melodic harmonization, modulation, transposition. Music majors should take this concurrently with Music 115-116. Skill course. Prerequisites: Music 65-66, 7-8, and keyboard proficiency. Half course each semester. *Staff*

**115S. Modal Counterpoint.** Polyphonic practice of the fifteenth and sixteenth centuries, sacred and secular music. Majors should take Music 107 concurrently. Prerequisite: Music 7-8, 65-66. One course. *Maves or Tirro*

**116S. Tonal Counterpoint.** Polyphonic practice of the seventeenth and eighteenth centuries, sacred and secular music. Prerequisite: Music 107, 115S. One course. *Maves or Tirro*

**122. Orchestration.** Characteristics and transpositions of the instruments of the symphony orchestra and concert band. Instrumentation from pre-existing piano scores, or the student's original compositions, for string, woodwind, brass, and percussion ensembles, orchestra and band. Prerequisite: Music 116S. One course. *Bryan*

**123S, 124S. Composition I.** Composing original music in the smaller forms for voice, piano, and other instruments. Studies in contemporary compositional techniques. Prerequisite: Music 65, 66 or consent of instructor. Two courses. *Hamilton and Maves*

**126T, 127T. Experimental Music.** The development of abilities necessary to compose music, utilizing either computer synthesized sound or the components available in the electronic music studio. Composition for conventional and non-conventional instruments. Prerequisite: Music 123S, 124S, and consent of instructor. Two courses. *Maves*

**130T, 131T. Performance Practice (Organ) I, II.** Analytical and practical study of organ compositions from various epochs. Registration, fingering, pedaling, ornamentation, touch, and *notes inégales* as described in ancient theoretical treatises and comments of composers. Paper and performances required. Prerequisite: One year of organ instruction at Duke or the equivalent, and consent of instructor. Music 130T is prerequisite to 131T. Two courses. *Douglass*

**132T, 133T. Performance Practice (Organ) III, IV.** Prerequisite: Music 131T for 132T, 132T for 133T. Two courses. *Douglass*

**141S, 142S. Music Theory III: Composition and Analysis.** The development of technical and expressive means in various media and styles. The completion of an original work in an instrumental or choral medium. Prerequisites: Music 116, 139, 158, or consent of instructor. Two courses. *Hamilton*

## HISTORY AND LITERATURE

**51, 52. Introduction to Music Literature.** The literature of music of Western civilization; acquisition of critical insights into musical styles, forms, and techniques. Representative works of major composers in all media, instrumental and vocal. Two courses. *Henry*

**125. Masterworks of Music.** Historical, biographical, and analytical study of works by major composers of the seventeenth through the twentieth centuries. One course. *Bone, Bryan, Mueller, or Saville*

**139. Twentieth Century Music.** Influential creative stylistic developments in music of the present century. A critical survey of works by Bartok, Berg,

Schönberg, Stravinsky, and Webern as a means of establishing a relative standard of values for subsequent independent exploration. Prerequisite: a one-year course in music theory or literature, or consent of instructor. One course. *Hamilton and Mueller*

**156S. Music History I: History of Music from 1600 to 1750.** Prerequisites: Music 7-8, 65, or consent of instructor. One course. *Saville or Kirkendale*

**157S. Music History II: History of Music from 1750 to 1830.** Prerequisites: Music 7-8, 65, or consent of instructor. One course. *Bryan or Kirkendale*

**158S. Music History III: History of Music from 1830 to 1910.** Prerequisites: Music 7-8, 65, or consent of instructor. One course. *Hamilton and Mueller*

**159S. Music History IV: History of Music to 1600.** Prerequisite: Music 7-8, 65, and two courses in music history, or consent of instructor. One course. *Kirkendale or Tirro*

**160. History of the Organ and Its Literature.** Historical survey of the organ from about 1450 to 1950, emphasizing development of the major national styles of building and composition; historical roots of the Flentrop organ. Prerequisite: one course in music theory or literature or consent of instructor. One course. *Douglass*

**163. Music in the Eighteenth Century.** Baroque, Rococo, and Classical styles and concepts represented in different instrumental and vocal genres; the composers and their historical and artistic environments. Prerequisite: one course in music theory or literature, or consent of instructor. One course. *Bryan*

**164. Music in the Nineteenth Century.** Romantic and post-romantic music; its relation to the artistic and literary movements of the century. Prerequisite: one course in music theory or literature, or consent of instructor. One course. *Mueller*

**165. Opera Literature.** History of the operatic idea from the Florentine Camerata in the late sixteenth century to the present. Relationship of music and text; opera as social commentary; changing forms and styles. One course. *Saville*

**166S. The Renaissance Madrigal.** History of the Italian madrigal and related forms from fourteenth century Ars Nova through the Renaissance and into the early Baroque periods. Consideration of musical, poetic, and cultural interrelationships. Prerequisite: ability to read music. One course. *Saville*

**174. Introduction to Jazz.** A multidisciplinary survey for non-majors which examines musical, aesthetic, sociological, and historical aspects of jazz. One course. *Tirro*

## INDEPENDENT STUDY AND SEMINARS

Admission to these courses will be subject to the approval of the Director of Undergraduate Studies and the instructor. The instructor and course content will be established in accordance with the individual student's interests and capacities.

**179, 180. Independent Study in Musical Performance.\*** Open only to sophomores possessing an exceptional technical and interpretive command of a musical medium. Prerequisites: previous registration in private instruction in applied music at Duke, audition, and consent of instructor. Two courses. *Staff*

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\*The schedule of fees for private lessons as published on page 180 is applicable to courses 179, 180, 181, 182, 183, 184.



**181, 182. Independent Study in Musical Performance.\*** Same as 179, 180, but for juniors. Two courses. *Staff*

**183, 184. Independent Study in Musical Performance.\*** Same as 179, 180, but for seniors. Two courses. *Staff*

**185S, 186S. Seminar in Music.** Guidance in the sources and materials of music and in the methods of stylistic analysis and criticism. A background of historical, stylistic, and theoretical knowledge is essential. Formal papers required. Two courses. *Staff*

**191, 192. Independent Study.** Directed reading, research, and musical analysis within a prescribed area of musical literature. Open only to qualified students in the junior year, by consent of the department. One or two courses. *Staff*

**193, 194. Independent Study.** Same as 191, 192, but for seniors. One or two courses. *Staff*

**195S, 196S. Seminar in Music.** Same as 185S, 186S, but for seniors; not necessarily restricted to candidates for degree with distinction. Two courses. *Staff*

## MUSIC EDUCATION AND PEDAGOGY

**57S, 58S, 59S, 60S. Vocal Diction.** Problems of diction for the singer. Study of standard pronunciation with special emphasis on phonetics in English, Italian, German, and French. Four half courses. *Hanks and Redding*

**128. Instrumental Conducting.** Development of techniques of conducting instrumental ensembles with emphasis on orchestral repertoire. Score-reading and analysis, principles of interpretation, and practical conducting experience. Prerequisite: Music 116S or consent of instructor. One course. *Bone*

**129. Choral Conducting.** Development of techniques of conducting vocal repertoire, ranging from church anthems to large-scale works. Score-reading and analysis, principles of interpretation, and practical conducting experience. Prerequisite: Music 116S or consent of instructor. One course. *Bone or B. Smith*

**151. Public School Music Education (Elementary).** Basic musical skills, music theory, and reading; song literature; rhythmic activities; listening; instruction on tonettes, recorders, autoharp, bells, selected percussion instruments, and piano chording. Half course. *Otto*

**152. Public School Music Education II (Elementary).** Continuation of Music 151 with emphasis on music appreciation as it pertains to social studies in public schools. Study and analysis of key words in music literature. Prerequisites: Music 151 or consent of instructor. Half course. *Otto*

## APPLIED MUSIC

The study of applied music concerns the understanding of music literature through performance. Private instruction is offered in instruments and voice. Class instruction is offered in small and large ensembles. Students must arrange an audition with the instructor prior to registration, either in person or by tape recording. All courses may be repeated for credit. Not more than two courses in the ensemble group (courses 100 and above) may be taken concurrently for credit.

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\*The schedule of fees for private lessons as published on page 180 is applicable to courses 179, 180, 181, 182, 183, 184.

**Instruction: ½ hour, quarter course credit**

- 80. Piano. *Evans, Lister-Sink, Ruggero, Smith, Turner, or Withers*
- 81. Strings. *Ciampi, Erdberg, Mueller, Plumb, or Raimi*
- 82. Woodwinds. *Dunigan, B. Fecteau, Henry, Listokin, Popkin, or Robinson*
- 84. Percussion. *Maves*
- 85. Voice. *Hanks, Lail, Redding, or Shaw*
- 86. Organ. *Douglass or Parkins*

**Instruction: 1 hour, half course credit**

- 90. Piano. *Evans, Lister-Sink, Ruggero, D. Smith, Turner, or Withers*
- 91. Strings. *Ciampi, Erdberg, Mueller, or Raimi*
- 92. Woodwinds. *Dunigan, B. Fecteau, Henry, Listokin, Popkin, or Robinson*
- 93. Brass. *Bergstone, Bryan. R. Fecteau, or Henes*
- 94. Percussion. *Maves*
- 95. Voice. *Hanks, Redding, or Shaw*
- 96. Organ. *Douglass or Parkins*
- 97. Jazz Improvisation. *Staff*

**Ensemble Classes: quarter course credit**

- 100. Symphony Orchestra. *Bone*
- 101. Wind Symphony. *Bryan*
- 102. Marching Band. *Henry*
- 103. Jazz Ensemble. *Staff*
- 104. String Ensemble. *Staff*
- 105. Wind Ensemble. *Staff*
- 106. Piano Ensemble. *Staff*
- 109. Chancel Singers. *Smith*
- 110. Collegium Musicum. *Tirro*
- 111. Opera Workshop. *Hanks*
- 112. Chapel Choir. *Smith*
- 113. Chorale. *Smith*

**Credit in Applied Music.** (Skill courses—credit not applicable to distributional requirements.\*) Credit for instruction in courses below 100 is granted on the basis of a half course per semester for one hour of private instruction per week and a minimum of six hours practice weekly; or a half course per year for one-half hour of private instruction, or one period of class study, and a minimum of six hours practice per week. An additional weekly class meeting for performance and criticism may be required by the instructor without additional credit. Credit for instruction in courses above 100 is granted on the basis of a half course per year for one rehearsal period of instruction and a minimum of three hours practice per week.

**Fees.** Students are charged for all applied music media below 100. Fees are payable to the Bursar's Office upon notification from that office at the beginning of each semester as follows:

One ½ hour private lesson per week for one semester	\$60.00
Two ½ hour private lessons per week or one 1-hour private lesson per week for one semester	\$120.00
One 1-hour class lesson per week for one semester	\$35.00

No charge is made for practice room facilities.

**DEPARTMENTAL MAJOR**

**Prerequisites.** Music 7-8, 65, 66, 107-108, and one year of applied music study in instrument or voice. Any or all of these may be exempted through demonstration of proficiency by examination and/or audition.

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\*Subject to instructor's approval, a student at an advanced level in applied music may take courses for tutorial and distributional requirements. These courses shall be designated by adding a T to the appropriate course number. Students who have not reached an advanced level will continue to take the regular applied music courses.

*Major Requirements.* Music 115, 116, 156S, 157, 158S, 159S, and one additional elective course in the department.

*Honors.* Students who are qualified (see section on Honors in this *Bulletin*) may undertake work leading to graduation with distinction in music by application to the Director of Undergraduate Studies. In addition to meeting the normal requirements of a major in the department, honors work usually involves participation in an appropriate junior-senior seminar and/or independent study. It must culminate in a paper, historical or analytical, either full length by itself or somewhat more concise if offered in conjunction with a recital or composition. The paper must be approved by a faculty committee.

## Naval Science

For courses in Naval Science, see *Reserve Officers Training Program*.

## Philosophy

Professor Peach, *Acting Chairman*; Assistant Professor Ross, *Director of Undergraduate Studies*; Professor Welsh; Visiting Professor Nowell-Smith; Associate Professors Mahoney, Roberts, and Sanford; Visiting Assistant Professors Bamford and Boudreaux

The undergraduate program in the Department of Philosophy is designed to acquaint the students with the content and the structure of philosophical theory in various areas. Discussion is encouraged so that the student can engage actively in the philosophical examination of problems.

Course offerings fall into two general categories: the systematic and the historical. In a systematic treatment, the organization of a course is primarily in terms of the problems presented by the subject matter of that course, as in logic, ethics, and metaphysics. In historical courses, attention is directed more to the order of development in the thought of a particular philosopher (Plato, Aristotle, Kant), or in a historical period. In all courses, reading of the works of philosophers will acquaint the students with the important and influential contributions to the definition and solution of philosophical issues.

The problems raised in philosophy in respect to the various fields of the arts and sciences involve questions which are not normally given attention in those particular disciplines. In the consideration of such problems, therefore, it is expected that the student will acquire some understanding and perspective of the major areas of man's intellectual endeavor. In this sense, philosophical comprehension is an essential part of a student's learning and education.

Philosophy provides a sound preparation for the demands of many professions. For example, the precision of argument and broad acquaintance with intellectual traditions emphasized in philosophy form an excellent basis for the study of law.

Only one of 41, 42, 43S, or 44S may be taken for credit. These courses are not open to juniors and seniors.

**41. Introduction to Philosophy.** Examination of problems in philosophy; emphasis on metaphysics and theory of knowledge. One course. *Staff*

**42. Introduction to Philosophy.** Examination of problems in philosophy; emphasis on ethics and value theory. One course. *Staff*

**43S. Introduction to Philosophy.** Philosophy 41 conducted as a seminar. One course. *Staff*

**44S. Introduction to Philosophy.** Philosophy 42 conducted as a seminar. One course. *Staff*

**48. Logic.** A study of the conditions of effective thinking and clear communication. Examination of the basic principles of deductive reasoning. One course. *Ross or Sanford*

**93. History of Ancient Philosophy.** The pre-Socratics, Socrates, Plato, Aristotle, and post-Aristotelian systems. Freshman prerequisites: previous philosophy course and consent of the instructor. One course. *Mahoney*

**94. History of Modern Philosophy.** Bacon, Hobbes, Descartes, Spinoza, Leibnitz, Locke, Berkeley, Hume, and Kant. Freshman prerequisites: previous philosophy course and consent of instructor. One course. *Peach or Roberts*

**101. Philosophy of Religion.** Selected concepts and doctrines. One course. *Roberts*

**102. Aesthetics: The Philosophy of Art.** The concept of beauty, the work of art, the function of art, art and society, the analysis of a work of art, criticism in the arts. One course. *Welsh*

**103. Symbolic Logic.** Detailed analysis of deduction and of deductive systems. Open to sophomores by consent of instructor. One course. *Ross*

**104. Philosophy of Science.** The principal philosophical and methodological problems in contemporary science. One course. *Ross*

**105. Philosophy of History.** History as a form of inquiry; problems of explanation; objectivity and the historical individual; general interpretations of the historical process. One course. *Staff*

**106. Philosophy of Law.** Natural law theory; legal positivism; legal realism; the relation of law and morality. One course. *Roberts*

**107. Political and Social Philosophy.** Discussion of the fundamental principles of political and social organizations. One course. *Mahoney*

**108. Social Ideals and Utopias.** Reading of selected Utopias; analysis of the value structures and political principles of these ideal societies. One course. *Staff*

**109. Philosophy of Language.** A philosophical analysis of problems arising in the study of language and symbolism. Topics include: theories of language, the nature of signs and symbols, theories of meaning, types of discourse (scientific, mathematical, poetic), definition, ambiguity, metaphor. One course. *Welsh*

**110. Epistemology.** A treatment of the problems of truth and knowledge; of *a priori* and empirical statements; and of theories of perception and probability. One course. *Sanford*

**111. Metaphysics.** A selection from the following: theories of substance, universals, identity, space, time, and causality; determinism and action; the relation of mind and body. Prerequisite: one course in philosophy. One course. *Sanford*

**112. Philosophy of Mind.** Such topics as mind and body, thought, perception, persons, and personal identity. One course. *Welsh or Roberts*

**116. Systematic Ethics.** Problems in moral philosophy: the nature of morality, ethical relativism, egoism, utilitarianism. Both historical and contemporary readings, with emphasis on the latter. One course. *Staff*

**117. Ancient and Modern Ethical Theories.** The development of ethical



thought in the West; the interaction between culture and ethical theory, with special reference to the Greek city-state, Roman law, the Renaissance, the Reformation, and the rise of modern science. Readings in the great ethical philosophers. One course. *Welsh*

**119. Medieval Philosophy.** Readings and discussion of Christian, Islamic, and Jewish philosophy from late antiquity to 1300. Special emphasis on the nature and destiny of man, human knowledge and conduct, and the question of the existence and nature of God. One course. *Mahoney*

**120. Late Medieval and Renaissance Philosophy.** Critical trends in fourteenth century philosophy; Renaissance Platonism, humanism and theories of love; Aristotelianism and the immortality controversy; the rebirth of skepticism; and the rise of modern philosophy. One course. *Mahoney*

**132. Nineteenth Century Philosophy.** Major nineteenth century philosophers; emphasis on the German tradition: Hegel, Schopenhauer, and Nietzsche. One course. *Bamford*

**134. Existentialism.** One or more major texts, such as Sartre's *Being and Nothingness*. One course. *Roberts*

**191, 192, 193, 194. Independent Study.** Directed reading and research. Open only to highly qualified students in the junior and senior year. By consent of the department. *Staff*

**196S, 197S, 198S, 199S. Seminars in Philosophy.** Prerequisite: one course in philosophy or consent of the instructor. One course each. *Staff*

## For Seniors and Graduates

**202. Aesthetics: The Philosophy of Art.** A study of some fundamental issues in aesthetics with particular reference to the fields of literature, music and painting. Problems discussed include the role of standards in criticism, aesthetic judgment, interpretation, evaluation in the arts, meaning in the arts, art and truth, the arts and morality. Open to juniors with the consent of the instructor. One course. (3 graduate units.) *Welsh*

**203. Contemporary Ethical Theories.** Study of the nature and justification of basic ethical concepts in the light of the chief ethical theories of twentieth century British and American philosophers. One course. (3 graduate units.) *Roberts*

**204. Philosophy of Law.** Natural law and theory and positivism; the idea of obligation (legal, political, social, moral); and the relation of law and morality. One course. (3 graduate units.) *Staff*

**205. Philosophy of History.** The nature of historical knowledge and inquiry; theories of the historical process. One course. (3 graduate units.) *Nowell-Smith*

**206. Topics in Ethical Theory.** One course. (3 graduate units.) *Staff*

**208. Political Values.** Analysis of the systematic justification of political principles and the political values in the administration of law. One course. (3 graduate units.) *Staff*

**211. Plato.** A critical study of selected dialogues, with emphasis on problems in epistemology and metaphysics. One course. (3 graduate units.) *Mahoney*

**217. Aristotle.** A study of passages from the *Organon*, *Physics*, *De Anima*, and *Metaphysics*. One course. (3 graduate units.) *Mahoney*

**218. Medieval Philosophy.** Selected problems in medieval philosophy. One course. (3 graduate units.) *Mahoney*

**225. British Empiricism.** A critical study of the writings of Locke, Berkeley, or Hume with special emphasis on problems in the theory of knowledge. One course. (3 graduate units.) *Peach*

**227. Continental Rationalism.** A critical study of the writings of Descartes, Spinoza, or Leibniz with special emphasis on problems in the theory of knowledge and metaphysics. One course. (3 graduate units.) *Peach*

**228. Recent and Contemporary Philosophy.** A critical study of some contemporary movements in philosophy with special emphasis on the work of Moore, Russell, Wittgenstein, Wisdom, and Ryle. One course. (3 graduate units.) *Welsh*

**230. The Meaning of Religious Language.** See course description for Religion 230. (Also listed as Religion 230.) 3 units. *Poteat*

**231. Kant's Critique of Pure Reason.** One course. (3 graduate units.) *Staff*

**232. Recent Continental Philosophy.** Selected topics. One course. (3 graduate units.) *Staff*

**233. Methodology of the Empirical Sciences.** Recent philosophical discussion of the concept of a scientific explanation, the nature of laws, theory and observation, probability and induction, and other topics. Prerequisite: consent of the instructor. One course. (3 graduate units.) *Ross*

**234. Problems in the Philosophy of Science.** Selected problems in the physical and nonphysical sciences such as space and time, measurement and determinism. Prerequisite: consent of the instructor. One course. (3 graduate units.) *Ross*

**241. Symbolic Logic.** Detailed analysis of deduction and of deductive systems. One course. (3 graduate units.) *Staff*

**251. Epistemology.** Selected topics in the theory of knowledge, e.g., conditions of knowledge, scepticism, and certainty, perception, memory, knowledge of other minds, and knowledge of necessary truths. One course. (3 graduate units.) *Sanford*

**252. Metaphysics.** Selected topics: substance, qualities and universals, identity, space, time, causation, and determinism. One course. (3 graduate units.) *Sanford*

**253. Philosophy of Mind.** Analysis of concepts such as thought and belief; issues such as mind-body relations, thought and action, the nature of persons and personal identity. One course. (3 graduate units.) *Roberts*

**254. Philosophy of Religion.** Topics such as proofs of the existence of God, meaningfulness of religious language, the problem of evil, immortality and resurrection. One course. (3 graduate units.) *Roberts*

**255. Philosophy of Action.** Problems in the individuation, characterization, and explanation of human actions; an analysis of such concepts as choosing, deciding, intending, doing, making, letting. One course. (3 graduate units.) *Sanford*

**260. Wittgenstein.** An examination of the *Tractatus* or the *Investigations*. One course. (3 graduate units.) *Welsh*

**287, 288. Foundations of Mathematics.** See description for Mathematics 287,

288. (Also listed as Mathematics 287, 288.) One course. (3 graduate units.) *Shoenfield*

**291, 292. Seminar in Special Fields of Philosophy.** One course. (3 graduate units.) *Graduate Staff*

## DEPARTMENTAL MAJOR

*Major Requirements.* Eight semester courses in philosophy of which at least six must be in courses numbered above 48. The following must be included; Philosophy 93 and 94; one non-introductory course in theory of value. Philosophy 48 is recommended, though not required.

*Related Work.* Two courses minimum in each of two departments approved by the philosophy adviser. Courses may not be those primarily open to freshmen. There is no restriction in principle as to departments in which related work may be taken, and the approval of the philosophy adviser is required only to insure some coherence in the program of major and related work as a whole.

The department offers work leading to graduation with distinction. See the section on Honors.

## Physics

Professor Walker, *Chairman*; Professor Roberson, *Director of Undergraduate Studies*; Professor Bilpuch, *Coordinator of General Physics*; Professors Biedenharn, Fairbanks, Gordy, Lewis, Meyer, Newson, Robinson, and Walter; Associate Professors Cusson, Evans, Fortney, and Hahn; Assistant Professors DeLucia, Friedman, Goshaw, Lawson, Lisowski, Loos, Nelson, and Smith; Instructors Chan, Garvey, Outlaw, and Von Behren; Lecturer Maripuu

Physics courses aim to develop in students a knowledge of the fundamental concepts of physics and the analytical skills necessary for scientific work. The undergraduate program provides students with appropriate academic background for positions in industry, government laboratories, or for graduate study. A program is also available which prepares the student for the study of medicine while giving him a strong background in physics.

**32. History of Physics.** Theories including Newtonian mechanics, atomic structure, quantum theory, relativity, nuclear and particle physics; their developers and technological applications. No previous knowledge of physics assumed. One course. *Walker*

**33. Energy: Principles, Problems, Alternatives.** Basic principles of physics as related to energy, the energy crisis, possible sources and alternatives, conservation, and environmental aspects of energy consumption. Optional special topics laboratory. No previous knowledge of physics assumed. One course. *Robinson*

**41, 42. Fundamentals of Physics.** For students interested in majoring in physics; taken in the freshman year. Basic principles of physics, mainly classical, at a level similar to Physics 51-52, but with emphasis on laying a foundation for further study. Three lecture-recitations and one three-hour laboratory. Prerequisites: approval of the Director of Undergraduate Studies; Mathematics 31-32 or equivalent (may be taken concurrently). Two courses. *Lewis*

**41P, 42P. Preceptorials.** Optional preceptorials for students enrolled in Physics 41, 42.

**51, 52. General Physics.** Basic principles of general physics treated

quantitatively. Designed for students entering medicine, engineering, and the sciences. Not open for credit to students who have completed Physics 41, 42. Students planning to major in physics should enroll in Physics 41, 42 in their freshman year. Prerequisites: Mathematics 31, 32 or equivalent (may be taken concurrently with consent of instructor). Two courses. *Bilpuch, Chan, Fairbanks, Friedman, Goshaw, Lawson, Loos, or Smith*

**51P, 52P. Preceptorials.** Optional preceptorials for students enrolled in Physics 51, 52.

**55. Introduction to Astronomy.** Man's evolving theory of the physical universe. Cosmological models, galaxies, stars, interstellar matter, the solar system, and experimental techniques and results. Optional observational laboratory. One course. *De Lucia*

**102. Applications of Modern Physics in Medicine.** Recent applications of physical phenomena in medical investigations including lasers, ultrasonics, X-rays, radioactivity, radiation therapy, cryogenics, and electronic techniques. Prerequisites: Physics 41, 42 or 51, 52. One course. *Walter*

**105. Introduction to Astrophysics.** Basic principles of astronomy treated quantitatively. Cosmological models, galaxies, stars, and interstellar matter, the solar system, and experimental techniques and results. Prerequisite: mathematics 31 or consent of instructor. One course. *De Lucia*

**106. Topics in Astrophysics.** Current topics with emphasis on contributions of the basic sciences. Experimental and observational opportunities. Prerequisite: Physics 55 (or 105) or consent of instructor. One course. *De Lucia*

**161. Modern Physics.** Relativity, quantum phenomena, atomic and molecular structure and spectra, solids, statistical physics, nuclear physics, elementary particles. Prerequisites: Physics 41, 42 or 51, 52 and Mathematics 32. One course. *Roberson*

**171. Electronics.** Elements of electronics including circuits, transfer functions, solid state devices, transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. Three lectures and one three hour laboratory. Prerequisites: Physics 41, 42 or 51, 52. One course. *Fortney*

**176S. Thermodynamics and Kinetic Theory.** Thermodynamics, kinetic theory, and elementary statistical mechanics. Prerequisites: Physics 41, 42 or 51, 52, and differential and integral calculus. One course. *Meyer*

**181. Introductory Mechanics.** Newtonian mechanics at the intermediate level, Lagrangian mechanics, linear oscillations, special relativity. Prerequisites: Physics 41, 42 or 51, 52 and differential and integral calculus. One course. *Fortney*

**185. Optics and Spectroscopy.** Wave motion, Fourier methods, geometrical and physical optics, coherence, lasers, and atomic and molecular spectra. Prerequisites: Physics 41, 42, or 51, 52, and differential and integral calculus. One course. *Loos*

## For Seniors and Graduates

**211, 212. Advanced Modern Physics.** Quantum theory with applications to the study of atoms, molecules, solids, and nuclei. Prerequisites: Physics 161, 181 or equivalents. Mathematics 285-286 or equivalent (may be taken concurrently). Two courses. (6 graduate units.) *Robinson*



**215. Introduction to Quantum Mechanics.** Wave mechanics and elementary applications; the hydrogen-like atoms; electron spin and angular momentum; operators and eigenvalues; stationary state perturbation theory; identical particles. Prerequisites: courses in modern physics and intermediate mechanics; Mathematics 285-286 may be taken concurrently. One course. (3 graduate units.) *Evans*

**217S, 218S. Advanced Physics Laboratory and Seminar.** Experiments involving the fields of mechanics, electricity, magnetism, heat, optics, and modern physics. Two courses. (6 graduate units.) *Meyer*

**220. Electronics.** Basic elements of modern electronics including a.c. circuits, transfer functions, solid state service. transistor circuits, operational amplifier applications, digital circuits, and computer interfaces. One course. (3 graduate units.) *Fortney*

**223. Electricity and Magnetism.** Electrostatic fields and potentials, boundary value problems, magnetic induction, energy in electromagnetic fields, Maxwell's equations, introduction to electromagnetic radiation. One course. (3 graduate units.) *Loos*

**225, 226. Elementary Investigations.** Training in the laboratory and library methods of physical research. Qualified students may conduct elementary investigations under the supervision of a member of the staff. Two courses. *Staff*

**268. Mathematical Foundations of General Relativity.** (Also listed as Mathematics 268.) One course. (3 graduate units.) *Cantor*

**280. Nuclear Reactor Physics.** Neutron diffusion theory, reactor criticality, kinetics, control, and reactivity effects. Slowing-down of neutrons, age theory, resonance absorption, temperature effects, and multigroup methods. Prerequisites: Physics 161; Mathematics 285-286 or equivalent (may be taken concurrently). One course. (3 graduate units.) *Cusson*

**282. Mechanics of Continuous Media.** Small vibrations, rigid body motion, hydrodynamics, elasticity. Prerequisites: Physics 41-42 or 51-52 and differential and integral calculus. One course. (3 graduate units.) *Walker*

## DEPARTMENTAL MAJOR

A student planning to major in physics should enroll in Physics 41, 42 in his freshman year. He should also arrange to complete the necessary mathematics as soon as possible.

### The A.B. Degree

*Prerequisites.* Physics 41, 42 or 51, 52 or equivalent; Mathematics 31, 32 or equivalent, 103, 104, or 131; two courses in another natural science.

*Major Requirements.* At least six semester-courses in physics from the available 100- and 200-level courses. Of these at least one course must be a laboratory course. A physics major also normally takes two courses of related work beyond the introductory level, in a program approved by his physics adviser.

### The B.S. Degree

*Prerequisites.* Physics 41, 42 or 51, 52 or equivalent; Mathematics 31, 32 or equivalent, 103, 104, or 131; two courses in another natural science.

*Major Requirements.* At least eight semester-courses in physics at the 100- and 200-level. These courses are normally Physics 161, 171, 176, 181, 211, 212,

218, and 223. Students planning graduate study are urged to take two or more electives in physics. A B.S. physics major also takes two courses of related work beyond the introductory level, in a program approved by his physics adviser.

The department offers to the student in his senior year the possibility of being associated with research conducted in this department. Such work may lead to graduation with distinction. See the section on Honors.

## Political Science

Professor Barber, *Chairman*; Professor Hall, *Director of Undergraduate Studies*; Professors Braibanti, Cleaveland, Grzybowski, Hallowell, Holsti, Hough, Kornberg, and Leach; Adjunct Professor Choudhury; Associate Professors Fish, Hawley, Johns, Paletz, Price, Rogowski, and Spragens; Assistant Professors Eldridge, McKean, Mishler, Salamon, Trilling, and Valenzuela; Lecturers O'Barr and Stone

Courses in political science for undergraduates are offered in four fields: (1) American Government, Politics, and Public Administration; (2) Comparative Government and Politics; (3) Political Theory and Methodology; and (4) International Law, Relations, and Politics. In each field, a basic course (numbered at the 90 level) serves as an introduction both to the study of political science and to the subject matter and approaches of the field, and middle and upper-level courses and seminars (numbered at the 100 and 200 levels respectively) consider particular aspects and topics within the field. In addition, opportunities for independent study under faculty supervision enable students to explore topics of special interest. Students majoring in political science are required to complete at least one course in each of three fields noted above. See page 200 for listing of courses by fields, as well as requirements of the major.

Special features of the department's undergraduate program include seminars, independent study, political internships, and honors. See appropriate subsections below.

Students commencing the study of political science, including those intending to major in the department, ordinarily will take at least one introductory course (91, 91D, 92, 93, or 94) before proceeding to advanced study within the department.

### INTRODUCTORY COURSES

Each of the following courses provides an introduction to the study of political science and serves as the basic course in one of the four fields of the discipline. Students ordinarily will take at least one of these courses before proceeding to more advanced courses. Some advanced courses may require a particular introductory course as a prerequisite of admission.

**91. The American Political System.** Theory and practice of American government and politics, federal-state relations, the separation and interrelationships of the executive, legislative, and judicial branches of government, judicial review, the role of political parties and public opinion, the formulation and execution of domestic and foreign policy, civil liberties. (Not open to students who have had Political Science 91D.) One course. *Staff*

**91D. The American Political System.** Introduction to American politics, emphasizing the impact of ideology and political culture and the role of parties and elections, interest groups and pluralist politics, and presidential leadership. Lectures and small discussion groups. (Not open to students who have had Political Science 91.) One course. *Staff*

**92. Comparative Politics.** Foundations of politics under modern regimes: democratic, authoritarian, totalitarian; the social and political conditions of change, both evolutionary and revolutionary; the bases of political conflict and violence; the role of elite groups, such as the military; mass movements and party systems, theories of development and underdevelopment; and the future of the modern corporate state. Films will be used. One course. *Valenzuela*

**93. Elements of International Relations.** The nature of international politics, the analysis of national power, the instruments of foreign policy, and the controls of state behavior. One course. *Eldridge or O'Barr*

**94. Contemporary Political Ideologies.** Liberalism, socialism, Marxism and its variants, fascism, contemporary democratic theory. One course. *Hallowell or Spragens*

## OTHER UNDERGRADUATE COURSES

**59S. Television and Politics.** Relationships of the organization, processes, and content of television to politics. Open only to freshmen. One course. *Paletz*

**100. Politics of Liberties and Equality.** Theory and development of the Bill of Rights and the Fourteenth Amendment with attention to Supreme Court decisions and cultural and political forces. One course. *Fish*

**101, 102. Introduction to the Civilizations of Southern Asia.** (Also listed as Interdisciplinary Course 101, 102.) One course. *Staff*

**103. Comparative Facism and Totalitarianism.** Modern Fascism in comparative and historical perspective; particular attention to German National Socialism. One course. *Rogowski*

**105. The Black American in Politics.** Behavior of Black people in the American political system, with special attention to voting organizations and the Black power movement. One course. *Staff*

**107. Comparative Environmental Policies.** Comparative analysis of environmental problems and policies in politically diverse industrialized nations including the United States, Russia, and Japan. (Also listed as Public Policy Studies 107.) One course. *McKean*

**108. The American Presidency.** The presidency and its impact on the American political system. One course. *Paletz*

**109. State and Local Government Today.** Problems in state, county, and city government. One course. *Leach*

**110. The Canadian Polity.** The Canadian political system from a behavioral perspective; relationships of the political culture, individual political behavior, and political institutions; with particular attention to distinctive regional, ethnic, and religious sub-cultures. One course. *Mishler*

**117. Comparative Legal Systems.** Origins, development, and mutual influences of modern legal systems: Roman and civil law; the Common Law and the Anglo-Saxon tradition; Islamic law; communist legal systems and the legal systems of Black Africa. One course. *Grzybowski*

**118. American Constitutinal Development.** Prerequisite: Political Science 91 or 91D, or consent of instructor. One course. *Fish*

**120. Conflict Resolution: Problems of War and Peace.** The causes and pre-

conditions of human conflict including such factors as deprivation, elite misconceptions, national myths, and civil strife. Consideration of restraints to violent conflict such as negotiation and bargaining. Relevant contemporary international issues such as Vietnam are studied within the context of current social science research. One course. *Eldridge*

**122. Modern International Politics.** An examination of the major problems of post-war international politics with particular attention to the extension of Soviet power, the Western response to this challenge, and the revolutions in the Afro-Asian world. One course. *Eldridge or O'Barr*

**123. Introduction to Political Philosophy.** The nature and enduring problems of political philosophy, illustrated by selected theorists in the Western political tradition. One course. *Hallowell or Spragens*

**124D. The Political Novel.** Politics and political concepts (totalitarianism, utopianism, fascism, nihilism, obligation and rights) as portrayed in the novels of Silone, Koestler, Orwell, Dostoevsky, and others. One course. *Staff*

**125. American Political Parties and Practical Politics.** A study of the historical development, organization, and methods of political parties in the United States. One course. *Mishler or Kornberg*

**126. Democratic Theory and Political Reality.** Normative goals and empirical analyses of existing democratic states. One course. *Spragens*

**127. Law and Politics.** Nature and functions of law; Anglo-American legal institutions, the process of judicial decision-making, and the relationships among judges, lawyers, legislators, and administrators in the development of public as well as private law. One course. *Fish*

**128. Congress and the Presidency.** Policy-making in the executive and legislative branches of the U.S. government, with particular attention to intra-governmental relations. One course. *Price*

**129. Groups in American Politics.** Theory and practice of the interest group approach to the study of American politics. One course. *Paletz*

**130. Politics and the Media of Mass Communication.** Activities of the media of mass communication as they affect the American political system and process. Governmental impact on the mass media. One course. *Paletz*

**131. Introduction to American Political Thought.** Basic elements in the American political tradition as developed from its English roots to the present. One course. *Staff*

**135. Comparative Legislative Behavior.** Structures, processes, functions, and behavior of legislatures, and legislative-like institutions in a variety of Western and non-Western societies with emphasis on the role of legislatures in policy formation, national integration, and modernization/development. One course. *Mishler*

**136. Comparative Government and Politics: Western Europe.** Modern political institutions and processes of Britain, France, Germany, and at least one of the smaller European democracies. Political consequences of divergent patterns of social and economic modernization; regional, religious, and class divisions; the modern role of parliaments; authoritarian, democratic, and pluralist alternatives in contemporary European societies. One course. *Rogowski*

**137. Political Behavior in Elections.** Political participation; public opinion;



voting behavior, sociological and psychological bases, comparative studies, models, and methodology of research. One course. *Trilling*

**138. Quantitative Analysis of Politics.** Basic applications of statistical tools of analysis of political phenomena. Emphasis on statistical inference. No prerequisites. (Not open to students who have had or are enrolled in Political Science 236, Psychology 117, Mathematics 53 or 183, Management Sciences 110, or Economics 138.) One course. *Trilling*

**139. Bureaucracy and Public Policy.** Analysis of the role of bureaucracy in the making and execution of public policy. One course. *Hall*

**140. Administrative Law and Government.** Fundamentals of the American system of law and government as reflected in the administrative process. One course. *Hall*

**141. Public Administration.** An introduction to the role of administration in the governmental process considering principles of administrative organization, methods of administrative control, personnel, and fiscal management. In general, the study of the organizational and administrative problems encountered by any government agency charged with carrying out public policy. One course. *Cleaveland or Hall*

**142. Administrative Responsibility.** An evaluation of political, legal, and administrative methods of achieving a responsible bureaucracy in American national government. Comparisons with relevant experience and techniques in other countries such as Great Britain and France. One course. *Hall*

**144. American Political Thought Since the Gilded Age.** The Progressive Period and the recurring themes of contemporary debate. Attempts to refurbish or develop alternatives to the dominant "liberal tradition." The ideological roots of black, feminist, and "conservative" protest. One course. *Price*

**145. Political Analysis for Public Policymaking.** (Also listed as Public Policy Studies 114.) One course. *Hawley, Salamon, or Stone*

**146. American Legislative Behavior.** Structure and operation of the legislative system with emphasis on background, attitudes and role perceptions, and decision-making behavior of national and state legislators. One course. *Mishler or Paletz*

**147S. Statutory Regulation of Political Activity.** The law of political activity, including such topics as campaign finance reform, lobbying, political influence in administrative decision-making, requirements for voting and candidacy, unethical practices in campaigns and office-holding, and political trials. One course. *Fleishman*

**148. Arab and Non-Arab Muslim World.** Political systems of major Muslim countries, emphasizing the role of Islam in defining the nature of these systems and current international politics of the Middle East. One course. *Braibanti*

**149. United States and East Asia.** Domestic and external factors influencing the perceptions and policies of the United States in East Asia, and interaction between the United States and Japan and China from the early 20th century to the Vietnam era. One course. *McKean*

**151. Introduction to Latin America Politics.** Historical and cultural context of political institutions and behavior; the role of traditional and emerging groups and forces; political instability and the decision-making process. One course. *Valenzuela*

**152. Authoritarianism and Revolution in Latin America.** Analysis of the politics of major countries including Argentina, Brazil, Chile, Cuba, and Mexico. One course. *Valenzuela*

**155. Problems of Political Development in the New States.** Survey of change and modernization in Africa and Asia; nationalism and neutralism, role of political parties, the military, and the bureaucracy in nation-building; economic growth and foreign aid. One course. *Braibanti*

**157. Foreign Policy of the United States.** Sources of American foreign policy, containment, international economic policy, deterrence, arms control, and disarmament. Prospects in the post-Vietnam era. Emphasis on the period since World War II. One course. *Holsti*

**158. Foreign Policy Decision-Making in the United States.** Individual, group, and organizational aspects. Emphasis on the period since World War II. One course. *Holsti*

**161. Comparative Government and Politics: Africa.** Nationalism, nation-building, and problems of development in sub-Saharan Africa. One course. *Johns*

**162. Comparative Government and Politics: Communist and Socialist Political Systems.** Communist and socialist movements in Europe, Asia, and the Third World; emphasis on party structure and ideology. One course. *Johns*

**163. Women in Developing Societies.** The diverse roles women played in Third World countries prior to European contact, the subsequent transformation under colonial rule, and the current reassessment by the governments of developing societies. One course. *O'Barr*

**165. Government and Politics of the Soviet Union.** Analysis of the Soviet political system, emphasizing the sources of stability and instability and the responsiveness of its policies. Literature on the non-Soviet world (notably the United States) will be included. One course. *Hough*

**166. Soviet Foreign Relations.** Nature of relations with other states. Determinants and formulation of foreign policy. One course. *Hough*

**168. Political Development in East Asia.** Divergent responses in Japan and China to the Western impact; the process of modernization; and the political instability which contributed to World War II. Emphasis on themes of nationalism and imperialism. One course. *McKean*

**169. Politics in Revolutionary China.** Political process and ideology in China since 1949. Emphasis on manipulation of the political culture and institutionalized revolution. One course. *McKean*

**170S. The Legal Process and Social Change.** The role of the legal systems in effecting and mediating social change. Consideration of different strategies and the circumstances in which they are effective. One course. *Fleishman*

**175. Political Parties and Legislatures in Western Democracies.** The origin, maintenance, and functions of party and legislative systems in Western democratic societies. One course. *Kornberg*

**176. Urban Politics.** Urban political processes and their impact upon urban policy. One course. *Salomon*

**180. Comparative Government and Politics: Southern Asia I.** Concepts of political development in new states, using India, Pakistan, Sri Lanka, and

Malaysia as case studies. Theory and practice of foreign aid and technical assistance as agents of political modernization. One course. *Braibanti*

**181. Comparative Government and Politics: Southern Asia II.** The political modernization of India and Pakistan since 1947. Constitutional developments as revealed in leading court judgments will be studied. Other topics will be the ideology of administrative reform, formulation of state polity, rural development, and party politics. One course. *Braibanti*

**184. Canada: Problems and Issues of an Advanced Industrial Society.** (Also listed as Interdisciplinary Course 184.) One course. *Preston and Visiting Lecturers*

**186. Political Leadership.** The development, characteristics, and impact of political leaders. Biographical and collective studies are considered primarily from a psychological perspective. One course. *Barber*

**188. The Psychology of Political Symbols.** The role of symbolic political issues in determining public attitudes and voting behavior. Symbolic political issues such as "law and order," pornography, and prohibition, distinguished from public welfare issues such as employment policies. One course. *McConahay*

**189, 190. Internship.** Open to enrollment by students engaging in practical political or governmental work experience during the summer or a regular semester. To enroll a student must obtain the approval of the Director of Undergraduate Studies, arrange employment, and secure the agreement of a departmental faculty member to supervise a program of study related to the work experience. Two courses.

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors by consent of the Director of Undergraduate Studies and of the individual instructor. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research. Open only to seniors by consent of the Director of Undergraduate Studies and of the individual instructor. Two courses. *Staff*

**195. Comparative Political Behavior in the United States and Canada.** Similarities and differences in political environments and their impact on political institutions and processes. One course. *Kornberg*

**197S. Principles and Methods of Political Inquiry.** Philosophical, scientific, and behavioralistic approaches to political problems; contemporary conceptual frameworks, including systems analysis and functionalism, group theory, and mathematical models. Prerequisite: consent of instructor. One course. *Staff*

**198. Senior Honors Seminar.** Open only to senior political science majors who are candidates for the degree with distinction. Preparation and writing of a research paper; group meetings to discuss common problems. Prerequisite: Political Science 197 or consent of the instructor.

**200S. A. Senior Seminar in American Government and Politics.** One course. *Staff*

**200S. B. Senior Seminar in Comparative Government and Politics.** One course. *Staff*

**200S. C. Senior Seminar in Political Theory.** One course. *Staff*

**200S. D. Senior Seminar in International Relations.** One course. *Staff*



## For Seniors and Graduates

**204. Ethics in Political Life.** Ethical issues arising in the conduct of political vocations and activities. (Also listed as Public Policy Science 204.) One course. (3 graduate units.) *Spragens*

**206. Politics and the Media.** The relationship between the media of mass communication and the American political process. Open to upperclassmen with consent of instructor. One course. (3 graduate units.) *Paletz*

**207. American Constitutional Interpretation.** Development of the constitution of the United States through Supreme Court decisions. Prerequisite: Political Science 127. One course. (3 graduate units.) *Fish*

**209. Problems in State Government and Politics.** One course. (3 graduate units.) *Leach*

**210. The Politics of Education.** The forces in local, state, and national politics which impinge on educational policymaking and administration. Not open to students who have had Political Science 313. (Also listed as Education 210.) One course. (3 graduate units.) *Leach*

**211. Contemporary Japanese Politics.** Postwar Japan with emphasis on the rapidly changing political culture, bureaucratic politics, the issue of imported democratic institutions, and the emergence of citizenship. One course. (3 graduate units.) *McKean*

**212. Japanese Foreign Policy.** The transition from militarism to pacifism in Japan's international posture, emphasis on the postwar American alliance, the questions of rearmament and nuclear weapons, and the domestic constraints on foreign policymaking. One course. (3 graduate units.) *McKean*

**214. Comparative Administrative Law.** Comparative analysis of the role of administrative techniques in established and transitional constitutional systems. French, German, British, and American patterns. Control of legality and expediency of various types of judicial review. One course. (3 graduate units.) *Grzybowski*

**215. Comparative Legislative Processes.** Analysis of the structures and functions of legislative institutions and of the behavior of legislative elites in both parliamentary and congressional systems. One course. (3 graduate units.) *Mishler*

**216S. Comparative Politics of the Welfare State.** Analysis of the political processes that shape very different solutions to similar social problems in advanced industrial nations. Examination of the development of income-maintenance programs and health care systems, with some discussion of other social policies. (Also listed as Public Policy Science 216S.) One course. (3 graduate units.) *Stone*

**217S. Economic Theories of Political Behavior.** Analysis of economic theories and other formal techniques applied to problems of voting behavior, legitimacy and constitutional choice, and to strategies of political conflict and coalition. One course. (3 graduate units.) *Rogowski*

**218S, 219S. Political Thought in the United States.** Writings of leading political theorists. First semester: founding fathers and their European and Puritan antecedents; the abolitionists and Calhoun. Second semester: Progressive period and recurrent themes of contemporary protest and debate. (Offered in alternate years.) Two courses. (6 graduate units.) *Price*



**220S. Problems in International Politics.** Prerequisites: one course on international relations, foreign policy, or diplomatic history. One course. (3 graduate units.) *Holsti*

**221. International Organization.** The functioning of the United Nations system and of regional organizations operating in the political and security fields. One course. (3 graduate units.) *Staff*

**222. Empirical Theory.** Critical examination of contemporary, non-normative conceptual frameworks for political inquiry, with emphasis on the qualifications of these frameworks as theories. One course. (3 graduate units.) *Trilling*

**223. Political Philosophy from Plato to Machiavelli.** Intensive analysis of the political philosophies of Plato and Aristotle, a survey of medieval political thought and an analysis of the significance of Machiavelli. One course. (3 graduate units.) *Hallowell*

**224. Modern Political Theory.** An historical survey and philosophical analysis of political theory from the beginning of the seventeenth to the middle of the nineteenth century. Attention is given to the rise of liberalism, the Age of Enlightenment, the romantic and conservative reaction, idealism, and utilitarianism. One course. (3 graduate units.) *Hallowell*

**225. Comparative Government and Politics: Western Europe.** Rise of modern political parties; extension of the suffrage; entry of bourgeoisie, peasants, and workers into politics; center-periphery conflicts; emergence of the welfare state and of planned economies; problems of "collectivist" politics. One course. (3 graduate units.) *Rogowski*

**226. Theories of International Relations.** Contemporary theories of international relations and foreign policy. Emphasis on the interdependence of theory and empirical research. One course. (3 graduate units.) *Eldridge*

**227. International Law.** Elements of international law, particularly as interpreted and applied by the United States; rights and duties of states with respect to recognition, state territory and jurisdiction, nationality, diplomatic and consular relations, treaties, treatment of aliens, pacific settlement of disputes, international regulation of the use of force, and collective responsibility. One course. (3 graduate units.) *Grzybowski*

**228. Soviet Public International Law.** Institutions and doctrines of the international law of peace as interpreted and applied by the Soviet government. Basic concepts including the theory of socialist international law and principle of peaceful coexistence. One course. (3 graduate units.) *Grzybowski*

**229. Recent and Contemporary Political Theory.** The rise of positivism and its impact upon modern political thought, the origins of socialism, Marxism and its variants, socialism in the Soviet Union, nationalism, fascism and national socialism, the crisis in modern democracy, Christianity and the social order. (Not open to students who have taken Political Science 132.) One course. (3 graduate units.) *Hallowell*

**230. American National Government.** Formation and contemporary operation of the national political system; historical and behavioral approaches. One course. (3 graduate units.) *Staff*

**231. American Political Theory.** An analysis of the main currents in American political thought from colonial beginnings to the present day, with emphasis

upon the development of liberalism in America. One course. (3 graduate units.) *Staff*

**233. Research Methodology.** Measurement, causal analysis, and comparison of different levels of analysis, and other problems in political research. One course. (3 graduate units.) *Trilling*

**235. The Commonwealth.** Analysis of political relationships among the members of the Commonwealth countries, with emphasis on Canada. One course. (3 graduate units.) *Staff*

**236. Statistical Analysis.** Introduction to statistics in political research, emphasizing inferential statistics through simple regression and correlation. One course. Not open to students who have had or are enrolled in Political Science 138, Psychology 117, Mathematics 53 or 183, Managerial Sciences 110, or Economics 138. (3 graduate units.) *Trilling*

**237S. Problems in American Foreign Policy.** The decision-making process as applied to contemporary foreign policy issues. Prerequisite: Political Science 122 or the equivalent. One course. (3 graduate units.) *Staff*

**238. Comparative Foreign Policy.** An application of comparative theory to the foreign policy decision-making processes of major, middle range, and developing states. One course. (3 graduate units.) *Eldridge*

**239S. Current Problems of International Law.** Theoretical trends, use of sources for research, role of international law in diplomacy and legal practice. For seniors and graduates only. One course. (3 graduate units.) *Grzybowski*

**241. Public Administrative Organization and Management.** The American administrative process: theory and practice of administrative organization and management. One course. (3 graduate units.) *Hall*

**243. Applications of Administrative and Organizational Theory.** Behavioral analysis of public organizations with emphasis on the impact of organizational structures, individual needs and motivation, and politics on the formulation and implementation of public policy. (Also listed as Public Policy Science 224.) One course. (3 graduate units.) *Hawley*

**244. Administrative Law and Process.** The nature and law of the administrative process in the context of American government and politics, with special attention to the powers, procedures, and judicial control of administrative agencies. One course. (3 graduate units.) *Hall*

**245S. Ethics and Policymaking.** (Also listed as Public Policy Science 223S.) One course. (3 graduate units.) *Price*

**246. Administrative and Public Policy.** The role of administration in the American policy process. One course. (3 graduate units.) *Hall*

**247. Political Participation and Policy Outcomes.** Impact of citizen participation upon governmental decision-making. Theoretical issues and empirical evidence (primarily American, but partly comparative). (Also listed as Public Policy Science 247.) One course. *Hough*

**248. The Politics of the Policy Process.** (Also listed as Public Policy Science 219.) One course. (3 graduate units.) *Behn and Salamon*

**249. Comparative Political Analysis and Political Development.** General methodology of comparison of political systems. Institutional, structural, functional, and configurative modes of analysis. Theory of political development.

Theoretical problems of induced political change. One course. (3 graduate units.) *Braibanti*

**250. Comparative Government and Politics: Southern Asia.** The political development of India and Pakistan. Contextual determinants of the political systems. Political consequences of partition. National integration, constitutional, and institutional aspects of the political systems. Impact of foreign technical assistance. One course. (3 graduate units.) *Braibanti*

**252. Comparative Political Behavior and Socialization.** Elites and mass publics in a variety of Western and non-Western societies including the United States; models of the political socialization process and their implications for democratic theory. One course. (3 graduate units.) *Mishler*

**253. Comparative Politics and the Study of Latin America.** Current literature on major themes of Latin American politics. One course. (3 graduate units.) *Valenzuela*

**257S, 258S. Modern East Asia.** Introduction to Problems and Literature. (Also listed as History 257S, 258S and as Interdisciplinary Course 257S, 258S.) Two courses. (6 graduate units.) *Dirlik, McKean, and Stone*

**260. The Tradition of Political Inquiry.** Past and present problems, goals, presuppositions, and methods. One course. (3 graduate units.) *Spragens*

**271. Political Processes in Traditional and Modern Africa.** Patterns of change in selected African societies from the pre-colonial to the post-colonial period, emphasizing the interaction between traditional, colonial, and post-colonial institutions and their impact upon African societies. One course. (3 graduate units.) *Johns*

**273. The American South as a "Developing Society."** The concept of modernization as a tool of social and political analysis, and its applicability in explaining the patterns of political and economic evolution in the American South. One course. (3 graduate units.) *Salamon*

**274. Political Psychology.** Psychological aspects of political performance by citizens, activists, and leaders. One course. (3 graduate units.) *Barber*

**275. The American Party System.** An intensive examination of selected facets of American national political parties, such as relationships between presidential and congressional politics, the politics of national conventions, recent foreign policy and party alignments, and the controversy over party government. One course. (3 graduate units.) *Kornberg*

**277. Comparative Party Politics.** The impact of social and political systems on party structures, functions, ideologies, and leadership recruitment. Emphasis upon research techniques and objectives. One course. (3 graduate units.) *Kornberg*

**278. Canadian Political Behavior in the North American Context.** Institutional processes and political behavior in Canadian and American societies. Impact of multi-partyism, federalism, political and cultural particularism, and the elite structure. One course. (3 graduate units.) *Kornberg*

**279. The Legislative Process.** An analysis of the structure and functions of Congress with emphasis on the behavior of legislators and resultant public policy. Some considerations will be given to American state and foreign legislatures. One course. (3 graduate units.) *Paletz*

**280. Comparative Government and Politics: Sub-Saharan Africa.** Politics



and government in selected African states, with particular attention to the problems of decolonization and modernization in the post-independence period. One course. (3 graduate units.) *Johns*

**283S. Congressional Policymaking.** Lawmaking and oversight of the bureaucracy by the United States Congress. Committee roles, impact of the executive and other external forces. (Also listed as Public Policy Science 283S.) One course. (3 graduate units.) *Price*

**285. The Judicial Process.** A study of judicial decision-making in the United States, with emphasis on the process of litigation, the recruitment of judges, the influences and limits on judicial decisions, and their impact within the political system. Prerequisite: Political Science 127 or 207 or the equivalent. One course. (3 graduate units.) *Fish*

**291. Problems of Urban Government.** One course. (3 graduate units.) *Leach*

**293. Federalism.** Theoretical and operational aspects of federal systems of government, focusing on the United States and Canada. One course. (3 graduate units.) *Leach*

## SEMINARS FOR UNDERGRADUATES

Each semester certain courses at both the 100- and 200-levels are offered as seminars and are so designated in the Official Course Schedule by an S following the course number. Enrollment is limited to fifteen students who ordinarily must receive consent of the instructor to be admitted; preference is given to political science majors.

The department also provides each year Senior Seminars in the four fields of political science. Prerequisites of admission ordinarily include the introductory (90-level) course and one 100- or 200- level course in the field represented by the seminar, and consent of the instructor. Preference in admission is given to seniors who are political science majors. For descriptions, see 200S, A, B, C, D.

## INDEPENDENT STUDY

Independent study, normally consisting of intensive reading and research and the preparation of a substantial written report or paper, permits the student to explore topics of special interest not covered by regular courses or seminars. Ordinarily undertaken in the junior and senior years following, or concurrent with, some course work in political science, independent study presupposes not only a special interest on the student's part in a particular topic but also an ability and willingness to work rigorously and independently in furtherance of that interest. Students possessing such interest and qualities, and desiring to undertake independent study, must request a member of the department faculty to supervise his or her work. Upon receiving in writing the agreement of the faculty member and approval of the Director of Undergraduate Studies, the student then registers for Political Science 191 or 192 in the junior year and 193 or 194 in the senior year. Students interested in making preliminary inquiries about independent study or in obtaining approval forms should see the Director of Undergraduate Studies.

## POLITICAL INTERNSHIPS

The Department of Political Science organizes an internship program each summer, primarily in Washington, D.C., for political science majors and interested non-majors. Students participate by qualifying for a position obtained by the department or by acquiring their own relevant employment. Opportunities



are available in Congress, the bureaucracy, with interest groups, and the media. In such employment, interns may or may not receive payment for their services; some qualify for financial aid through the University. Weekly sessions with guest speakers in Washington are arranged to supplement the interns' work experiences. Course credit can be obtained by enrolling in Political Science 189 or 190, either during the summer or a regular semester, and writing an analytical paper. Application forms are available in the department office (214 Perkins). Potential applicants should contact the internship director, Professor David Paletz, at any time but preferably early in the fall semester.

## HONORS IN POLITICAL SCIENCE

A special opportunity for qualified political science majors is the department's honors program, successful completion of which enables the participant to achieve graduation with distinction in political science. The central feature and requirement of the program is the honors thesis which the student prepares under faculty supervision; other aspects of the program, such as a special seminar for honors candidates, are intended primarily to assist the student in the choice and formulation of the research topic and the preparation of the thesis.

Participation in the program is open to political science majors who by the spring semester of the junior year show promise of achieving at least a *B* average in political science by the time of graduation and give evidence of interest in, and capacity for, the skillful research and writing required for the preparation of a thesis of high (at least *A-*) quality. Students taking part in this program ordinarily begin by enrolling in Political Science 197S in the spring semester of the junior year, although in exceptional cases alternative approaches are possible. In Political Science 197S, attention is given to basic approaches and methods that may be used in defining and developing the topic of the thesis, and initial steps are taken in the selection and design of the student's research project. In the fall semester of the senior year while enrolled in Political Science 198, student-participants undertake the research and writing required for the thesis. In some cases the thesis is completed by the end of the fall semester; normally, however, work on the thesis continues into the next semester. In either event, the thesis must be submitted to a faculty committee by late March of the senior year. That committee reads the thesis, conducts an oral examination of the student concerning the thesis, and determination whether the thesis is of sufficiently high quality to merit a recommendation that the student be graduated with distinction in political science. The faculty committee, in consultation with the director of the honors program, also assigns final grades for Political Science 197S and 198, thereby replacing the *Z* previously assigned in those courses.

Further information concerning the honors program may be obtained from the director of the program or the Director of Undergraduate Studies.

## POLITICAL SCIENCE COURSES BY FIELDS

Political science courses for undergraduate are offered in four fields, as noted below; students majoring in the department must complete at least one course in each of three fields.

*American Government, Politics and Public Administration:* Political Science 91, 91D, 59S, 100, 105, 108, 109, 118, 125, 127, 128, 129, 130, 137, 139, 140, 141, 142, 145, 146, 147S, 170S, 176, 186, 188, 189, 190, 191\*, 192\*, 193\*, 194\*, 198\*, 200S A,

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\*If subject-matter is appropriate to field.

206, 207, 209, 210, 230, 241, 243, 244, 246, 247, 248, 273S, 274, 275, 279, 283S, 285, 291.

*Comparative Government and Politics*: Political Science 92, 101, 102, 103, 107, 110, 117, 135, 136, 148, 151, 152, 155, 161, 162, 163, 165, 168, 169, 175, 180, 181, 184, 191\*, 192\*, 193\*, 194\*, 195, 198\*, 200S B, 211, 214, 215, 216S, 217S, 225, 235, 250, 252, 253, 257S, 258S, 271, 277, 278, 280, 293.

*Political Theory and Methodology*: Political Science 94, 123, 124D, 126, 131, 138, 144, 191\*, 192\*, 193\*, 194\*, 197S, 198\*, 200S C, 204, 218S, 219S, 222, 223, 224, 229, 231, 233, 236, 245S, 249, 260.

*International Law, Relations and Politics*: Political Science 93, 120, 122, 149, 157, 158, 166, 191\*, 192\*, 193\*, 194\*, 198\*, 200S D, 212, 220S, 221, 226, 227, 228, 237S, 238, 239S.

## DEPARTMENTAL MAJOR

*Requirements*: Eight courses in political science including (1) at least one course in each of three fields; (2) at least two courses at the 200 level; and (3) no more than three cross-listed courses originated outside the Department of Political Science. (Such cross-listed courses appear in the preceding listing without descriptions.)

*Suggested Work in Related Disciplines*: Several courses in such disciplines as anthropology, economics, history, philosophy, psychology, public policy, religion, and sociology are desirable.

## Psychology

Professor Alexander, *Chairman*; Professor Wing, *Director of Undergraduate Studies*; Professors Bevan, Borstelmann, Carson, Diamond, R. Erickson, Guttman, Jones, Lakin, Lockhead, H. Schiffman, Staddon, and M. Wallach; Adjunct Professor Campbell; Associate Professors Coie, Costanzo, C. Erickson, Hall, and McConahay; Assistant Professors Aderman, Eckerman, Fischer, Kalat, Kremen, Levy, Norton, Robinson, Roth, and White; Lecturers Casseday, Clifford, E. Crovitz, H. Crovitz, Davis, Gehman, Gentry, Marsh, Oppenheim, Peele, Shows, Somjen, L. Wallach, and Wolbarsht; Adjunct Instructor Musia Lakin; Research Associate S. Schiffman; Visiting Scholars Giora and Moulton

**70S, 71S. Freshman Seminars.** Intensive experience through the study of one or two problems of special interest. Does not fulfill departmental prerequisites. Prerequisite: consent of the Director of Undergraduate Studies. Half course or one course each. *Staff*

The following four first-level courses are open to freshmen, sophomores, juniors, and seniors without prerequisite. Some of these courses will have discussion sections or preceptorials, with the availability of these experiences to be specified prior to registration. Students in each of these courses are expected to participate as subjects in three to six hours of psychological research. An individual student need fulfill this requirement only once, even though he takes more than one course at this level.

**102. Sensation, Perception, and Learning.** Sensation, including psychophysics and receptor processes. The concept of reflex, both physiological (Sherington) and behavioral (Pavlov). Complex organization: learning, perception and cognition. One course. *Bevan, Guttman, Lockhead, Schiffman, or Staddon*

**103. Biological Basis of Behavior.** Behavior as a product of evolution and

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\*If subject-matter is appropriate to field.

the role of behavior in species survival. Neural and endocrine factors in reproduction, hunger, thirst, emotion, and intelligence. Heredity-environment in the development of behavior. One course. *Diamond, C. Erickson, Kalat, or Norton*

**104. Personality.** Representative theories of personality, from Freud to the present, emphasizing problems of normal personality structure, dynamics, development, and assessment. One course. *Alexander, Carson, or Kremen*

**105. Developmental Psychology.** Theory and research on growth and behavior from infancy to adolescence. One course. *Borstelmann, Coie, Costanzo, or Eckerman*

**Intermediate and Advanced Lecture Courses.** Some of these offerings will include discussion sections or preceptorials, as specified prior to registration.

**110. Applied Psychology.** Applications of psychology to problems of personnel selection, industrial efficiency, advertising, and selling. Prerequisite: one course in psychology. One course. *Staff*

**111. Social Psychology.** Problems, concepts, and methods in the study of social interaction and interpersonal influence. Prerequisite: Psychology 102, 103, 104, 105, or consent of the instructor. One course. *Aderman or Jones*

**117. Statistical Methods in Psychology.** Elementary statistical techniques and their application to the analysis and interpretation of psychological data. Theory of inference is stressed. Psychology majors only. (Not open to students who have had Economics 138, Mathematics 53 or 183, Management Sciences 110.) One course. *Staff*

**122S. Seminar in Child Observation.** Children are observed in the group setting of the University Preschool and Primary Program. Aspects of personality, social development, and child-adult relationships. Open only to junior and senior psychology majors with consent of instructor. One course. *Musia Lakin*

**127. Learning and Adaptive Behavior.** The principles of instrumental learning in animals and man. Prerequisite: Psychology 102 or 103. One course. *Staddon*

**128. Systems of Psychology.** The main systems in psychology from the mid-nineteenth to mid-twentieth centuries; the introspectionist, functionalist, behaviorist, psychoanalytic, Gestalt, and structuralist positions; the work of Titchener, James, Dewey, Watson, Hull, Freud, Wertheimer, Kohler, and Piaget. Prerequisites: Psychology 102 or 103 and 104 or 105. One course. *Bevan, Guttman, or Kremen*

**129. Survey of the History of Psychology.** Landmarks in systematic psychology from early Greek science to the present. Prerequisites: Psychology 102 or 103 and 104 or 105. One course. *Bevan, Guttman, or Kremen*

**131. Visual Perception.** Structure and function of visual systems, perception of form and brightness, color vision, depth perception, adaptation, and perceptual development. Prerequisite: Psychology 102, 103, or consent of the instructor. One course. *White*

**132. The Psychology of Individual Differences.** Nature and causes of individual and group variations in intelligence, special abilities, social and emotional characteristics. Prerequisite: Psychology 102 or 103 and Psychology 117. One course. *Wing*

**133. Biological Aspects of Learning.** Evolution of learning abilities; spe-



cialized learning abilities; physiological mechanisms of learning. Prerequisite: Psychology 102 or 103. One course. *Kalat*

**134. Psychology of Language.** An integrative, theoretical approach to psycholinguistics stressing the relation of language and speech to other areas in psychology. One course. *Robinson*

**135. Hormones and Behavior.** The endocrine system and hormones in maternal, sexual, and emotional behavior. Prerequisite: Psychology 103. One course. *C. Erickson*

**137. Physiological Basis of Perception.** Basic concepts and current theories on the neural mechanisms involved in the processing of sensory information. Prerequisite: Psychology 102 or 103. One course. *Norton*

**138. Abnormal Psychology.** Disordered behavior and constructive personality change are viewed in interpersonal and social context for purposes of understanding normal and abnormal personality development and functioning. Prerequisite: Psychology 104 or 105. One course. *Carson, Lakin, or Schiffman*

**139. Motivation.** Contemporary use of such concepts as instinct, drive, and expectancy in the explanation of behavior; the role of nervous mechanisms and hormones in the control of goal-directed behavior. Prerequisite: Psychology 102 or 103. One course. *Guttman*

**Laboratory Courses (140 through 149).** These courses are open chiefly to juniors and seniors. The subject matter varies, but these courses have in common a concern with the design and execution of psychological experiments. Students will find them helpful as a means of gaining experience before engaging in independent study.

**140S. Research Methods in Child Psychology.** Prerequisite: Psychology 105. One course. *Coie, Eckerman, or L. Wallach*

**141S. Tests and Measurements.** Test methods used by psychologists to measure and evaluate mental processes. Prerequisite: Psychology 117 or the equivalent. One course. *Schiffman or Wing*

**142S. Instrumental Behavior.** Laboratory course using animal subjects in operant-conditioning situations. Prerequisite: Psychology 102. One course. *Guttman or Staddon*

**143S. Experimental Methods in Cognitive Psychology.** Human cognition; language, memory, problem-solving, and other higher mental processes. One course. *Staff*

**144S. Learning and Adaptive Behavior.** Basic principles of adaptive behavior in animals, with special emphasis on the effects of reinforcement. Participation in experiments with animals. Prerequisite: Psychology 102, 103, or consent of instructor. One course. *Staddon*

**145S. Experimental Approaches to Personality.** Methods applied to personality research. Prerequisite: Psychology 104. One course. *Costanzo, Schiffman, or Wallach*

**146S. Experimental Comparative Psychology.** Animal behavior from evolutionary and physiological viewpoints. Emphasis on methodology. Prerequisite: Psychology 102 or 103. One course. *C. Erickson or Kalat*

**147S. Experimental Social Psychology.** Group dynamics, attitude change, and interpersonal perception. Prerequisite: Psychology 111. One course. *Aderman or Jones*



**148S. Psychology of Perception and Thinking.** Basic phenomena of perception and thinking as determined by conditions in the external situation and in the person—biological and psychological. Prerequisite: Psychology 102. One course. *H. Crovitz, Lockhead, or White*

**149S. Physiological Psychology Laboratory.** Neural bases of behavior, sensory and motor functions of the nervous system, and problems of emotion, motivation, and consciousness. Laboratory in psychophysics and the electrical activity of the nervous system. Prerequisite: consent of the instructor. One course. *R. Erickson*

**152S. Psychological Approaches to Contemporary Problems.** Relevance of various psychological theories and findings to selected contemporary issues. Prerequisite: consent of the instructor. One course. *Staff*

**154S. Education, Children, and Poverty.** Psychological hypotheses concerning the roles of preschool intervention programs, improved quality of resources, teacher expectancy effects, and enhancement of pupil self-confidence, in relation to the goal of improved cognitive competence for poverty background children. Criteria for defining competence, such as scores on psychometric intelligence tests, performing on Piagetian tasks, and development of specific skills. Interpretations concerning intelligence and cognitive deprivation in poor children in the light of relevant psychological evidence. Prerequisite: one course in psychology or consent of instructor. One course. *M. Wallach*

**165S. Personality Theory.** Theories of personality from larger metatheoretical perspectives. Open to junior and senior majors in psychology or by consent of the instructor. Prerequisite: Psychology 104. One course. *Alexander or Kremen*

**170S. A-D. Seminar in Selected Problems.** One course each. *Staff*

**Tutorial Study.** For juniors and seniors. Small group discussions about influential books and articles in psychology. The availability of tutorials, their content, and their instructors will be announced before registration.

**171T, 172T. Junior Tutorial.** Prerequisites: Psychology 102 or 103; Psychology 104 or 105, and consent of the Director of Undergraduate Studies. Half course or one course each semester. *Staff*

**173T, 174T. Senior Tutorial.** Prerequisites: Psychology 102 or 103; Psychology 104 or 105; Psychology 117 or the equivalent; and consent of the Director of Undergraduate Studies. Half course or one course each semester. *Staff*

**177, 178. Independent Study and Research.** Prerequisites: formulation of a study plan with a faculty supervisor and approval of the Director of Undergraduate Studies; Psychology 102 or 103, 104 or 105, and one psychology course numbered 140 through 149; Psychology 117 recommended. One or two courses each semester. *Staff*

**191, 192. Junior Honors Research.** Directed reading and research. Open only to qualified juniors who expect to graduate with distinction in psychology. Prerequisite: consent of the director of honors program. One or two courses each semester. *Staff*

**193, 194. Senior Honors Research.** Directed reading and research for seniors planning to graduate with distinction in psychology. Prerequisite: consent of the director of honors program. One or two courses each semester. *Staff*

Courses at the 200-level are open to selected undergraduates only with written consent of the instructor.

## For Seniors and Graduates

**203. Sensation and Perception.** An examination of the classical concepts in sensation and perception and of the resulting psychophysical data for each of the major senses with emphasis on vision and audition. Modern perceptual formulations are discussed through analysis of the empirical evidence in support of each view. One course. (3 graduate units.) *Lockhead*

**206. Comparative Psychology.** Eminent comparative psychologists and their work. One course. (3 graduate units.) *Kalat*

**210. Cognitive Psychology.** Theoretical approach; stresses interconnections across perception, memory, thinking, language, and use of models. One course. (3 graduate units.) *Robinson*

**212. Human Memory.** Literature, classical and modern; data and theories relating to mechanisms of information processing, storage, and retrieval. One course. (3 graduate units.) *Bevan*

**213. Adaptive Behavior.** The principles of adaptive behavior in animals, with special emphasis on the effects of reward and punishment. Prerequisite: consent of instructor. One course. (3 graduate units.) *Staddon*

**214, 215. Developmental Psychology.** Current research and theory. First semester: comparative and biological approaches to human development. Infancy and social development. Second semester: cognitive development. Two courses. (6 graduate units.) *Eckerman, L. Wallach, and Staff*

**216. Biological Psychology.** The methods of biology (as applied to psychology), especially in neurophysiology, neuroanatomy, and genetics. Topics covered include: the genetics of behavior, the organization of the dorsal thalamus and neocortex, and the limbic system and hypothalamus. Methods covered include: ablation method, method of evoked potential, electrical stimulation of the brain, and classical and physiological genetics. One course. (3 graduate units.) *Diamond*

**217. Social Psychology.** Social factors in cognition, models of social interaction, conformity, and social influence, and attitude development and change. One course. (3 graduate units.) *Jones*

**218. Research Methods in Social Psychology.** Emphasis on the interplay between experimental design and technique. One course. (3 graduate units.) *Aderman*

**219. Neural Bases of Behavior.** Structure and function of the nervous system as related to problems of sensory-motor processes, learning, and memory. One course. (3 graduate units.) *R. Erickson*

**228. Visually Guided Behavior.** Anatomical and physiological maturation of the nervous structures mediating visual behaviors. How the maturation of the visual pathway may contribute to the development of these behaviors. One course. (3 graduate units.) *Norton*

**230. Social Behavior of Animals.** Developmental, ecological, and physiological aspects of territorial, sexual, parental, and aggressive behavior. One course. (3 graduate units.) *C. Erickson*

**234. Seminar in Personality.** Selected topics of current interest concerning empirical research on personality. Strategies for the definition of research questions and the evaluation of research progress. One course. (3 graduate units.) *M. Wallach*

**238. Electroencephalogram and Psychological Function.** A survey of experimental and clinical literature on brain wave correlates of intelligence, personality, behavior disorders, epilepsy, sleep, sensory stimulation, reaction time, and attention. Emphasis on the electrophysiology of conditioning and learning. Lectures, laboratory demonstrations, and clinical case presentations. One course. (3 graduate units.) *Marsh*

**245. Personality Theory I.** Representative theories of human functioning, from Freud to neoanalytic approaches. One course. (3 graduate units.) *Alexander, Kremen or Schiffman*

**246. Personality Theory II.** Representative models of human functioning, as field theory, behavior theory, type or trait theory, and ego psychology. One course. (3 graduate units.) *Alexander, Kremen or Schiffman*

**253. Psychological Approaches to Public Policy Analysis.** (Also listed as Public Policy Science 253.) One course. (3 graduate units.) *McConahay*

**261. Science, Politics, and Government.** The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Science 255 and Sociology 261.) One course. (3 graduate units.) *Bevan or McKinney*

**271S. Selected Problems.** One course. (3 graduate units.) *Staff*

**273-274. Statistical Principles in Experimental Design.** The problems of scientific inference; methods of data analysis and issues in experimental design. Two courses. (6 graduate units.) *Roth*

**276. Neuroanatomical Basis of Sensory Physiology.** Original papers are read and discussed which are concerned with the neuroanatomical substrates underlying sensory processing in the auditory and visual systems. (Also listed as Anatomy 276.) One course. (3 graduate units.) *Hall*

**280. Psychology as a Science.** Epistemology of psychology in its historical evolution from Mach, Newton, and Kant through Darwin, Freud, and Hull; emphasis on practice in current areas of science; roles of research techniques and language, construct usage, hypotheses, and general processes of developing understanding in various current areas. One course. (3 graduate units.) *R. Erickson*

**282. Introduction to Methods of Psychotherapy.** Current trends in psychotherapeutic practice and research. Application of principles drawn from theories of personality to individual and group psychotherapy.; consent of the instructor. One course. (3 graduate units.) *Carson or Martin Lakin*

**283, 284. The History of Psychology.** First semester: Aristotle to Kant; second semester: development of modern psychology. Prerequisite for 284: Psychology 283 or consent of instructor. Two courses. (6 graduate units.) *Guttman*

**291. Seminar in Community Mental Health.** Psychological epidemiology and ecology; primary, secondary, and tertiary prevention; the public-health approach to problems of psychological disorders and psychological well-being. Focus on intervention techniques, such as consultation and community action planning. One course. (3 graduate units.) *Staff*

**293. Methods in Developmental Psychology.** Methodological and epistemological issues in research in development. Individual and group research projects are an integral part of the course. One course. (3 graduate units.) *Staff*



## DEPARTMENTAL MAJOR

*Major Requirements.* Eight courses in psychology, including 102 or 103 and 104 or 105, Psychology 117, plus five additional psychology courses of the student's selection. Mathematics 53, 183, Economics 138, or Management Science 110 may be substituted for Psychology 117 but do not count as one of the eight required courses.

Students seeking a B.S. degree must complete, in addition to the above requirements, a minimum of two calculus courses and six additional courses in the natural sciences or mathematics.

## Public Policy Studies

Professor Fleishman, *Director*; Associate Professor Hawley, *Associate Director*; Assistant Professor Decker, *Director of Undergraduate Studies*; Professors Estes (Medicine) and Hough (Political Science); Adjunct Professor Lange (Law); Associate Professors Behn, Blaydon, Dajani, Grabowski, McConahay, and Price; Assistant Professors Cook, Fischer, Goodwyn, Lipscomb, Salamon, and Stack; Lecturers Kuniholm, Payne, Stone, and Vaupel.

The policy studies major is an interdisciplinary social science program designed to provide students with the skills, analytical perspectives, and descriptive information which policy analysts need to deal effectively with major contemporary social problems. The course of study familiarizes the student with the kind of contribution each of several disciplines (political science, economics, social psychology, applied mathematics, and the humanities) can make to policy analysis. Opportunities are provided, both in the classroom and through field experiences, for students to integrate this material and apply it to analyzing specific public policy issues.

The students majoring in public policy are able to participate in a variety of learning experiences including seminars, lecture discussion classes, individual study, policy workshops, and an internship. In addition, students are urged to participate actively in numerous programs sponsored by the Institute which supplement the material covered in class. As a matter of policy, students are asked to evaluate teaching and course content and are provided both formal and informal opportunities to shape the Institute's program and curriculum.

Courses in public policy are open to all students providing that the prerequisites (if any) cited for individual courses are met.

**55. Analytical Methods for Public Policymaking.** Basic concepts of analytical thinking including quantitative methods for assessing the probabilities of outcomes and appraising policy alternatives. Illustrated by problems faced by busy decision makers in government, law, medicine, etc. One course. *Behn, Fischer, or Vaupel*

**107. Comparative Environmental Policies.** Comparative analysis of environmental problems and policies in several industrialized nations with widely differing political systems, including the U.S.A., the U.S.S.R., and Japan. Emphasis on the variety of possible responses and unforeseen policy problems, and the factors which influence these. One course. (Also listed as Political Science 107.) *McKean*

**110. Economic Analysis for Public Policymaking: Microeconomic and Non-Probabilistic Models.** Application of microeconomic analysis to public policy areas, including agriculture, housing, taxation, and income redistribution. Prerequisite: Economics 52 or equivalent. One course. *Cook or Lipscomb*



**112. Policy Evaluation and Experimentation.** Uses and limitations of statistical methods, including experimentation, for monitoring and evaluating public policies. Prerequisite: Public Policy Studies 55. One course. *Staff*

**114. Political Analysis for Public Policymaking.** Analysis of the political and organizational processes which influence the formulation and implementation of public policy. Alternative models. (Also listed as Political Science 145.) One course. *Hawley, Salamon, or Stone*

**116. Policy Choice as Value Conflict.** Theoretical and practical problems in decision-making in relation to conflicts of value and of interest. How norms deriving from professional ethics, ideology, law, and other sources are manifest in such policy issues as welfare, environmental management and national defense. One course. *Payne or Decker*

**131S. The Politics of Educational Reform.** Contemporary demands for the reform of public schools in light of the history of reform efforts and various theories of social action and organizational change. First half of semester. *Hawley*

**132S. Multinational Enterprises and Public Policy.** Current controversies concerning the policies of the U.S. and other countries toward foreign investments by large business firms. First half of semester. Half course. *Vaupel*

**133S. The Termination of Public Policy.** Case study approach to efforts to terminate public programs; process by which established programs acquire a political constituency and resulting difficulties. First half of semester. Half course. *Behn*

**134S. Politics of Professionals.** Professions as quasi-governments. Impact of licensing, certification, codes of ethics, and self-regulation on volume and quality of professional services. Mechanisms for achieving accountability to the public. First half of semester. Half course. *Stone*

**171S. Family, Life Cycle, and Public Policy.** Examination of assumptions and politics that have led to existing family policy in complex societies. Implication of cross cultural analysis for the reformulation of public policies affecting family life. First half of semester. Half course. *Stack*

**172S. Social Observation and Advocacy Workshop.** Research methods and the process of problem formation and advocacy in the southeast, focusing on selected social issues such as the family, child welfare, and aging. Prerequisite: Public Policy Studies 171 or consent of instructor. Last half of semester. Half course. *Stack*

**174. Technology Assessment and Social Choice.** (Also listed as Engineering 174.) One course. *Clark and Garg*

**175S. The Palestine Problem and United States Public Policy.** Identification of Arab and Zionist perceptions; alternatives available to American decisionmakers; interest group pressures on U.S. policies; historical analysis to the improvement of public policy. One course. *Kuniholm*

**176S. Television Documentaries and Public Policy.** The role of documentary television in explaining and altering policy. First half of semester. Half course. *Payne*

**183. American Journalism in Conflict.** Fundamental issues in American journalism from perspectives of the newsman, the official, and the public. Conflicts between an adversary press and claims of national security, public access to the media, protection of news sources, advocacy, and contemporary political reporting. Case studies of current interest. One course. *Staff*

**184S. Effect of Mass Media, Particularly Television, on Political Attitudes.** Impact of mass media. Research on various "theories" of the influence of the media. One course. *Vanocur*

**185. United States Foreign Policy and the Press.** Impact of the reporting of international events. Roles and influences of foreign correspondents. Special references to Great Britain, Vietnam, and the Soviet Union. One course. *Staff*

**186S. The Shaping of the News.** The press as a social and political institution. Treatment of the news by editors and journalists including economic, political, and professional concerns, management policies, and automation of the newsroom, relations with sources, and ethnic, racial, and religious composition of audiences. One course. *Staff*

**190. Internship.** For students working in a public agency, political campaign, or other policy-oriented group under the supervision of a faculty member. Prerequisite: prior consent of Director of Undergraduate Studies. One course. *Staff*

**191, 192. Independent Study.** Directed reading and research. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research for seniors. Two courses. *Staff*

### For Seniors and Graduates

**204S. Ethics in Political Life.** (Also listed as Political Science 204.) One course. (3 graduate units.) *Spragens*

**216S. Comparative Politics of the Welfare State.** (Also listed as Political Science 216S.) One course. (3 graduate units.) *Stone*

**217. Microeconomics and Public Policymaking.** Consumption and production theory, welfare economics, theories of collective choice, market structures and regulation, and nonmarket decision-making. One course. (3 graduate units.) *Cook, Lipscomb, or Behn*

**219. The Politics of the Policy Process.** A formulation of public policy-making, substantive policies in a variety of contexts from local government to international affairs; the role of legislatures, interest groups, executive branches, and the bureaucracy in defining alternatives and in shaping policy from agenda formulation to implementation. (Also listed as Political Science 248.) One course. (3 graduate units.) *Behn or Salamon*

**221. Analytical Methods I: Decision Analysis for Public Policy Makers.** Methods for structuring decision dilemmas and decomposing complex problems, assessing the probabilities of uncertain consequences of alternative decisions, appraising the decision maker's preferences for these consequences and for reexamining the decision. (Not open to students who have taken Public Policy Studies 55.) One course. (3 graduate units.) *Blaydon, Fischer, or Behn*

**222. Analytical Methods II: Data Analysis for Public Policy Makers.** Sampling theory, Bayesian statistics, and regression analysis. Examples from problems in health care, transportation, crime, urban affairs, and politics. (Not open to students who have taken Public Policy Studies 112.) One course. (3 graduate units.) *Behn, Fischer, or Vaupel*

**223S. Ethics and Policymaking.** Normative concepts in politics—liberty,

justice, the public interest: historical and philosophical roots; relationship to one another and to American political tradition; and implications for domestic policy problems. (Listed also as Political Science 245.) One course. (3 graduate units.) *Price*

**224. Applications of Administrative and Organizational Theory.** (Also listed as Political Science 243.) One course. (3 graduate units.) *Hawley*

**231. Analytical Methods III: Evaluation of Public Programs and Policies.** Theoretical treatment of cost-benefit analysis; discussion of several prospective and retrospective evaluations of public programs and policies. Examples from law enforcement, health, income maintenance and other policy areas. Prerequisites: Public Policy Studies 55 or Public Policy Sciences 221, 112 or 222, and 110 or 217, or Economics 149. One course. (3 graduate units.) *Cook and Fischer*

**232. Analytical Methods IV: Regression and Simulation Techniques for Policy Analysis.** The theory and policy-oriented applications of regression analysis and simulation techniques. Includes an introduction to the use of several standard computer programs. One course. (3 graduate units.) *Cook and Vaupel*

**233. Analytic Approaches to Bargaining, Cooperation, and Competition.** Application of principles of game theory, economics, and psychology to labor-management negotiation, plea bargaining, public interest group formation, corporate collusion, business mergers, and arms limitations. One course. (3 graduate units.) *Blaydon and Fischer*

**246. Population Policy.** (Also listed as Sociology 246.) One course. (3 graduate units.) *Back*

**247. Political Participation and Policy Outcomes.** (Also listed as Political Science 247.) One course. (3 graduate units.) *Hough*

**252S. National Security Policy.** Application of decision analysis and normative and organizational theory and historical systems, to major strategic decisions, and selected foreign policy issues. One course. (3 graduate units.) *Fischer and Kuniholm*

**253. Psychological Approaches to Public Policy.** Contribution of psychological analysis to an understanding of social issues such as poverty, drug abuse, crime, crowding, and race relations, the ways problems are recognized, and why different policy alternatives are selected, (e.g., those that "blame the victim,"). (Also listed as Psychology 253.) One course. (3 graduate units.) *McConahay*

**254. Transportation Planning and Policy Analysis.** (Also listed as Civil Engineering 216.) Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. One course. (3 graduate units.) *Behn or Dajani*

**255. Science, Politics, and Government.** An examination of the structure and values of the scientific community; the mechanisms and strategies of government; and their mutual interdependence in American society. (Also listed as Psychology 255 and Sociology 261.) One course. (3 graduate units.) *Bevan and McKinney*

**256. The Economics of Health Care.** One course. (3 graduate units.) *Lipscomb*

**260S. Public Policy Research Seminar: The Administration of Justice.** One course. (3 graduate units.) *Staff*

**261S. Research Seminar: Health Policy.** Determinants and impacts of

public policies designed to improve the equity and efficiency of health services. The supply and distribution of services; the cost of services and alternative modes of financing; the quality of services and alternative mechanisms of quality control. Applied research paper. One course. (3 graduate units.) *Lipscomb and Stone*

**262S. Research Seminar: Communications I.** One course. (3 graduate units.) *Staff*

**263S. Public Policy Research Seminar: Urban and Regional Development Policy.** Dynamics of urban and regional development analyzing alternative policy instruments for coping with the social, environmental, and economic effects. Housing, land use, transportation, taxation, environmental protection, and related urban development problems and policies. Prerequisite: Political Science 176, Political Science 109, Economics 234 or consent of instructor. One course. (3 graduate units.) *Salamon*

**264S. Public Policy Research Seminar: Topics in Public Policy I.** Selected topics. One course. (3 graduate units.) *Staff*

**270S. Humanistic Perspectives on Public Policy.** Modes of inquiry into aspects of social life important to policy makers but beyond the normal reach of social science. Reading from James Agee, Robert Coles, Eudora Welty, James Baldwin, George Eliot, and others. Prerequisite: consent of instructor. One course. (3 graduate units.) *Payne and Coles*

**271. The Uses of History in Public Policy-Making I.** Introduction to historical analysis as a technique for formulating and evaluating public policy. (Also listed as History 203.) One course. (3 graduate units.) *Staff*

**272. Poverty in Non-Urban America: An Historical Perspective on the Inadequacy of Public Policy.** An historically based exploration of the social, political, and cultural sources; contemporary policy alternatives. One course. (3 graduate units.) *Decker*

**273. The Uses of History in Public Policy II.** Introduction to historical analysis as a technique for formulating and evaluating public policy. Emphasis on public policy decisions abroad since World War II, including the structuring of selected contemporary problems in light of their historical contexts. One course. (3 graduate units.) *Kuniholm*

**275. Class, Ethnicity and Social Policy.** The uses of anthropological modes of analysis for understanding social issues and public policy with a focus on class, work, ethnicity, sex roles, and the family. (Also listed as Anthropology 277.) One course. (3 graduate units.) *Stack*

**283. Congressional Policy-Making.** (Also listed as Political Science 283S.) One course. (3 graduate units.) *Price*

## INTERNSHIP COURSES

The Institute's internship courses provide students with an opportunity to develop a basic understanding of one or more public policy areas, to test that understanding on the job during the summer (stipends are provided for students who qualify for financial assistance), and to return to the classroom to build on this knowledge and experience. Normally, students take the entire course sequence to receive credit for the field experience requirement of the public policy studies major. Applications for enrollment in the internship courses must be obtained in the early fall from the Director of Internship Programs.



**151S, 152S, 153S. Administration of Justice.** Analysis of policy problems and conflicts involved in the operation of the criminal justice system. Sequential courses: spring, summer (including internship), and fall. Prerequisite: consent of instructor. Three courses. *Brannon, Cook, and Stone*

**154S, 155S, 156S. Communications Policy.** Analysis of policy problems and conflicts involved in governmental regulation of the media of communication. Sequential courses: spring, summer (including internship), and fall. Prerequisite: consent of instructor. Three courses. *Broder, DeVries, Lange, and Witcover*

**157S, 158S-159S. Health Policy.** Analysis of health care problems and policies. Sequential courses: spring, summer (including internship), and fall. Prerequisite: consent of instructor. Three courses. *Cooper, Havighurst, Lipscomb, or Stone*

## THE MAJOR

*Prerequisites.* Economics 2 or 52, Political Science 91, and Public Policy Studies 55.

*Major Requirements.* Public Policy Studies 110, 112, 114, 116, plus three additional courses one of which must be a 200-level course. A policy-oriented field experience approved by the Director of Undergraduate Studies is required; if course credit is secured through the field experience, it may count as one of the three additional courses.

## Religion

Professor Poteat, *Chairman*; Professor Osborn, *Director of Undergraduate Studies*; Professors Bradley, Jones, Long, Phillips, and Price; Associate Professors Charlesworth, Kort, Lawrence, McCollough, Meyers, Partin, and Wintermute; Assistant Professors Bland, Burford, and Corless; Visiting Assistant Professor Breyspraak; Lecturers Sapp and Shows

Study in the Department of Religion should arise from or lead to the awareness that an understanding of religion is crucial to an understanding of persons and of human societies. The curriculum is designed to develop this understanding in two distinct but inseparable ways; first, through the examination of the particulars of specific religious traditions; and, second, through theoretical studies of an analytic, comparative, and constructive nature.

Introductory courses (Religion 50, 52, 55, 57, 58, and 59) are open to all undergraduates. These courses also help fulfill distributional requirements for the religion major and are therefore cross-listed at the head of appropriate divisions of the curriculum. One-hundred level courses normally are open to juniors and seniors without prerequisite. Freshmen and sophomores who have completed one course below 100 may be admitted to 100-level courses with the exception of junior-senior seminars. Courses at the 200-level are open to upper-classmen with the consent of the instructor.

## INTRODUCTORY COURSES

**50. The Old Testament.** Historical, literary, and theological investigations. Not open to students who have had Religion 55 or 55D. One course. *Staff*

**52. The New Testament.** Origins, development, and thought. Not open to students who have had Religion 55 or 55D. One course. *Staff*

**55. The Religion of the Bible.** A historical, cultural, and theological study

of the Old and New Testaments. Not open to students who have had Religion 50, 50D, 52, 52D. One course. *Staff*

**50D, 52D, 55D.** Same as 50, 52, 55 with discussion section included. One course each. *Staff*

**57. Introduction to Religions of Asia.** Problems and methods in the study of religion, followed by a survey of the historical development, beliefs, practices and contemporary significance of the Islamic religion and religions of South and East Asia. One course. *Staff*

**58. Interpretations of Religion in Western Culture.** Western religion as explained by contemporary sociologists, psychologists, anthropologists, and theologians. One course. *Staff*

**59. Problems in Theology and Ethics.** Philosophical, theological, and cultural problems, such as the existence of God, ethical theory, religious language, and the relation of religion to culture. One course. *Staff*

## RELIGIOUS TRADITIONS: THEIR ORIGINS AND DEVELOPMENT

### African and Asian Traditions

#### Introductory Course 57.

**71A, 72A. Freshman-Sophomore Seminars: African and Asian Traditions.** Topics and instructors to be announced. Two courses. *Staff*

**113. African Philosophy.** (Also listed as Black Studies 113.) One course.

**140. Religions of India.** Major religious traditions of the subcontinent. Hinduism, Buddhism, Jainism, and Islam. One course. *Bradley or Lawrence*

**141. Religions of China and Japan.** Traditional religion in China and Japan and its interaction with Sino-Japanese Buddhism. One course. *Corless*

**147. Muhammad and the Qur'an.** The Qur'an in relation to the religious experience, life, and work of Muhammad. One course. *Partin*

**148. Introduction to the Civilization of Southern Asia.** (Also listed as Interdisciplinary Course 101.) One course. *Staff*

**149. Buddha and Buddhism.** A systematic introduction to the origins and spread of Buddhist thought and practice. One course. *Corless*

**195A, 196A. Junior-Senior Seminars: African and Asian Traditions.** Topics and instructors to be announced. Two courses. *Staff*

**217. Islam in India.** History and thought of major Indian Muslims from Biruni to Wali-Ullah, with special attention to the role of Sufism. An introduction to selected Muslim scholars and saints who contributed to the interaction between Islam and Hinduism in Northern India during the second millenium A.D. One course. (3 graduate units.) *Lawrence*

**218. Religion in Japan.** A survey of religion in Japan, with specific emphasis on indigenization and attempts at synthesis. An approach to the meaning of the words *religious* and *secular* in the Japanese situation. One course. (3 graduate units.) *Corless*

**284. The Religion and History of Islam.** Origins and development of the Islamic community and tradition, with particular attention to the religious element. One course. (3 graduate units.) *Partin*

**285. The Vedic Tradition: Compilation and Interpretation.** Indian canonical

writings with emphasis on the literary stages in relation to later philosophical and religious movements. One course. (3 graduate units.) *Lawrence*

**286. Religious Trends in Modern India.** Leaders and movements among the religions from the coming of the Europeans to Independence. One course. (3 graduate units.) *Bradley*

**287. Scriptures of Asia.** Intensive study of translations of basic texts from the religious traditions of India, China, and Japan. One course. (3 graduate units.) *Bradley*

**288. Buddhist Thought and Practice.** A historical introduction to Buddhist thought and practice, with special attention to their interrelationship in the living religion. One course. (3 graduate units.) *Corless*

### **Jewish and Christian Traditions**

**Introductory Courses 50, 52, 55, and 50D, 52D, 55D.**

**71B, 72B. Freshman-Sophomore Seminars: Jewish and Christian Traditions.** Topics and instructors to be announced. Two courses. *Staff*

**104. The Prophets of the Old Testament.** Their historical setting and message. One course. *Wintermute*

**105. Theology of the Old Testament.** Emphasis upon history and eschatology, covenant, messianism, and wisdom. One course. *Staff*

**106. Jesus and the Synoptic Gospels.** The gospel tradition in the New Testament. One course. *Charlesworth or Price*

**107. Theology of the New Testament.** A systematic analysis of the theologies of the New Testament writers and an attempt to synthesize the basic and shared themes. One course. *Charlesworth or Price*

**108. The Life and Letters of Paul.** Paul's role in the expansion of the Christian movement, the most important aspects of his thought, and his continuing influence. One course. *Charlesworth or Price*

**111. The Historical Jesus.** Historical research on the life of Jesus. One course. *Charlesworth or Price*

**115-116. Introduction to Biblical Hebrew.** (Divinity School courses open to undergraduates with permission of the instructor.) Elements of phonology, morphology, and syntax. Exercises in reading and writing Hebrew. Second semester: study of the weak verb; exegetical treatment of the Book of Jonah. Two courses. *Bailey*

**120. History of the Christian Church.** Crucial events, issues, forms and writings that have shaped the Christian community and influenced Western civilization from the time of the early church. One course. *Jones*

**121. Christianity in Europe from the Middle Ages to the Protestant Reformation.** The decline of the medieval Church and the origins of the Protestant Reformation. One course. *Staff*

**122. Protestantism and Catholicism in Modern Europe.** Reformation and Counter-Reformation, confessionalism, religious conflicts, and the secularization of European Christianity. One course. *Staff*

**124. Christianity in America.** Representative men, movements, and thought in American Christianity. One course. *Jones*

**128. The Background of Contemporary Christian Thought: 1918-1960.**

Theology of Karl Barth, Rudolf Bultmann, Paul Tillich, Karl Rahner, Reinhold Niebuhr, and others. One course. *Osborn*

**129. Contemporary Christian Thought, 1960 to the Present.** Trends in contemporary theology, such as secular theology, theology of hope, and liberation theology. One course. *Osborn*

**131D. Principles of Archeological Investigation.** Supervised field work, visits to other excavations, introduction to ceramic chronology, numismatics, and other related disciplines. Excavation of a late Roman village in Galilee. Offered in Israel, only in the summer. One course. *Meyers*

**132D. Palestine in Late Antiquity.** The history, literature, and archeology of Roman Palestine with particular emphasis on Galilee in rabbinic and early Christian times. One course. *Meyers*

**133. The Foundations of Post-Biblical Judaism.** History, religion, and literature of Pharasaic and sectarian Judaism from the time of Ezra to Rabbi Judah. One course. *Meyers*

**134. Jewish Mysticism.** The main historical stages, personalities, texts, and doctrines from rabbinic to modern times. One course. *Bland*

**135. Jewish Religious Thought.** Doctrines, dialectics, and religious attitudes of pre-Enlightenment theologians. One course. *Bland*

**136. Contemporary Jewish Thought.** Modern Jewish thought from Mendelssohn to the present, with particular reference to American thinkers. One course. *Meyers*

**137. Jewish Ritual and Theology.** Introduction to thought and practice as reflected in the historical and literary development of *The Prayer Book*. One course. *Bland*

**139. Modern Hebrew.** Representative texts from the modern period, with an introduction to the colloquial language of Israel. One course. *Staff*

**145. Religious Quests of the Greco-Roman World.** Sectarian Judaism, the Mystery Cults, and Gnosticism. One course. *Wintermute*

**195B, 196B. Junior-Senior Seminars: Jewish and Christian Traditions.** Topics and instructors to be announced. Two courses. *Staff*

**207, 208. Second Hebrew.** Historical Hebrew grammar with reading and exegesis of Old Testament prose and poetry. (Also listed as OT 207, OT 208 in the Divinity School.) Prerequisite: at least one year of Hebrew or consent of instructor. Two courses. (6 graduate units.) *Staff*

**220. Third Hebrew.** An interpretive study of late Hebrew prose, with readings from *Chronicles*, *Ecclesiastes*, and the *Mishnah*. One course. (3 graduate units.) *Meyers*

**221. Readings in Hebrew Biblical Commentaries.** Selected Hebrew texts in Midrash, Aggadah, and other Hebrew commentaries reflecting major trends of classical Jewish exegesis. One course. (3 graduate units.) *Bland*

**228. Theology of the Gospel and Epistles of John.** A study of the origin of these writings, the provenance of their thought forms and symbolism, their influence on the early church, and their contemporary significance. One course. (3 graduate units.) *Price*

**239. Introduction to Middle Egyptian.** Grammar and readings in hiero-



glyphic texts relating to the Old Testament. One course. (3 graduate units.) *Wintermute*

**244. The Archeology of Palestine in Hellenistic-Roman Times.** The study of material and epigraphic remains as they relate to Judaism in Hellenistic-Roman times, with special emphasis on Jewish art. One course. (3 graduate units.) *Meyers*

**248. Theology of Karl Barth.** A historical and critical study of Barth's theology. One course. (3 graduate units.) *Osborn*

**258. Coptic.** Introduction to the Sahidic dialect with selected readings from Christian and Gnostic texts. Prerequisite: one year of Greek or consent of instructor. One course. (3 graduate units.) *Wintermute*

Students interested in acquiring additional linguistic tools required for graduate courses in Biblical studies are referred to the offerings of the Classical Studies Department for elementary Greek and the *Divinity School Bulletin* for courses in Aramaic.

## ANALYTIC, COMPARATIVE, AND CONSTRUCTIVE STUDIES

**Introductory Courses 58 and 59.**

**71C, 72C. Freshman-Sophomore Seminars: Analytic, Comparative, and Constructive Studies.** Topics and instructors to be announced. Two courses. *Staff*

**125. Religion and Theology of Black America.** Black religion in its historical and social context, with critical appraisal of major works. One course. *Burford*

**126. Themes in Christian Theology.** Study of Christian teachings concerning God, Jesus Christ, sin, and salvation; intended to serve as a basis for the student's evaluation of his own religious concepts. One course. *Osborn*

**130. Christian Ethics.** Ethical implications of Biblical religion, the historical development of Christian ethics, and the ethical dimensions of contemporary social life. One course. *McCollough*

**142. Myth and Symbol.** Historical and phenomenological study of religious myths and symbols. One course. *Partin*

**143. Mysticism.** The mystical element of religion: Hinduism, Buddhism, Christianity, and Islam. One course. *Bradley*

**146. Modalities of the Sacred.** Analysis of the structure of hierophanies in relation to religious and cultural history. One course. *Long*

**150. Religion and Human Sexuality.** A study of the current sexual revolution with the aim of examining options and determining relevant Judaic and Christian attitudes and actions. One course. *Phillips*

**151. Ethical Issues in Social Change and Public Policy.** American moral tradition and factors in social change in the normative analysis of public policy, with a consideration of specific ethical issues. One course. *McCollough*

**154. Ethics and Modern Technology.** Emerging ethical issues created by the impact of technology on the psychological, social, political, and economic life of modern man. One course. *Breytspraak*

**155. Ethical Issues in the Life Cycle.** Human development viewed in religious, ethical, and psychological perspectives. One course. *McCollough*

**156. Christian Marriage and the Family.** Marriage and the family in American society studied from the Christian perspective. One course. *Phillips or Sapp*

**158. Psychology and Religion.** Contributions of major psychological theories to an understanding of religion, especially Christianity. One course. *Shows*

**170. Problems of Religious Thought.** Analysis of credentials for belief in God. One course. *Poteat*

**174. Religion and the Poetics of Vision.** The liturgical shaping of life as embodied in selected works of painting and sculpture. One course. *Poteat*

**178. Existentialism.** Religious roots, development, and contemporary expressions. One course. *Burford*

**187. Religious Elements in Classical and European Literature.** A consideration of the religious elements in representative writings. One course. *Kort*

**188. Recent Literature and its Religious Implications.** Religious elements in recent literature. One course. *Kort*

**195C, 196C. Junior-Senior Seminars: Analytic, Comparative, and Constructive Studies.** Topics and instructors to be announced. Two courses. *Staff*

**212. Policymaking and Theological Ethics.** Relation of knowledge, power, and values in policy making; models of decision making in the policy sciences and their ethical implications. One course. (3 graduate units.) *McCollough*

**232. Religion and Literature: Perspectives and Methods.** Selected literary works as interpreted by myth or archetype critics and by theological critics. One course. (3 graduate units.) *Kort*

**233. Modern Narrative and Religious Language.** Fiction of selected American, British, and continental writers of the first half of the twentieth century, with special attention to the role of religious language in their work. One course. (3 graduate units.) *Kort*

**238. Jewish Responses to Christianity.** Apologetic and polemical themes in rabbinic, medieval, and contemporary writings. One course. (3 graduate units.) *Bland*

**272S. Topics in Comparative Theology.** Theological categories in Christian and Eastern religious traditions, focusing on such topics as man, God, salvation and eschatology. One course. (3 graduate units.) *Lawrence and Osborn*

**280. The History of Religions.** A study of the methodology of the history of religions, the nature of religious experience, and specific categories of religious phenomena. One course. (3 graduate units.) *Partin*

**282. Myth and Ritual.** Historical and phenomenological study of myth and ritual in their interrelationships in the history of religions, with particular attention to religious pilgrimage. One course. (3 graduate units.) *Partin*

**289. World Religions and Social Change.** The contemporary role of Buddhism, Christianity, and Islam in Asia and Africa. One course. (3 graduate units.) *Bradley*

## INDEPENDENT STUDY

**191, 192. Independent Study.** For freshmen and sophomores with departmental approval. Two courses. *Staff*

**193, 194. Independent Study.** For juniors and seniors with departmental approval. Two courses. *Staff*

## DEPARTMENTAL MAJOR

*Major Requirements.* Eight courses, which must include at least two introductory courses (numbered 50 through 59). The distribution of courses must also include at least one each from the categories "African and Asian Traditions," "Jewish and Christian Traditions," and "Analytic, Comparative, and Constructive Studies."

The student, in consultation with an assigned adviser and with the adviser's approval, should elect four of the eight courses in such a way that they will constitute a thematic or methodological concentration on a particular aspect of religion.

The Department of Religion has been well aware in designing its major program that the majority of students electing to major in religion are seeking a liberal arts education. Therefore the students take courses in at least two religious traditions as well as in the area of analytic, comparative, and constructive studies, and are encouraged to take a wide range of electives or to focus them to reflect their own developing interests.

To prepare for graduate or professional study of religion, the Department of Religion recommends that majors complete at least two years of college-level study, or the equivalent, of a foreign language. Master of Arts and Doctor of Philosophy programs often require examination in one or two foreign languages. Students planning to attend a theological seminary should note that knowledge of Biblical languages, as well as Latin, frequently is presupposed or required. Those planning to pursue studies of Asian religions should begin appropriate language study as part of their undergraduate preparation.

*Honors.* The department offers work leading to graduation with distinction. For further information consult the Director of Undergraduate Studies in Religion and the section on Honors in this *Bulletin*.

## Reserve Officers Training Program

### AIR FORCE AEROSPACE STUDIES

Professor Dutton, Lt. Colonel, USAF, *Chairman*; Assistant Professor Vesel, Captain, USAF, *Director of Undergraduate Studies*; Assistant Professors Griffin, Major, USAF; and Spencer, Captain, USAF.

**Eligibility Requirements.** All freshmen, male or female, are eligible to enroll in the General Military Course in the Air Force ROTC. For enrollment in the Professional Officer Course, the student must have completed successfully either the General Military Course or the six weeks Field Training Course; must execute a written agreement with the government to complete the Professional Officer Course; must be sworn into the enlisted reserve; and must agree to accept a commission in the United States Air Force Reserve upon graduation.

**Deposit.** Each student must make a deposit of ten dollars with the Bursar's Office to ensure return of all government property.

### General Military Courses

#### *First Year*

**1. United States Military Forces in the Contemporary World.** Development of aerospace power in the United States; mission, doctrine, and organization of the United States Air Force; and its relationship to the other services within the Department of Defense. (May not be counted to satisfy graduation requirements.) Half course. *Dutton*

#### **4. Corps Training.** No course credit. *Staff*

##### *Second Year*

**51. Development of Air Power.** Growth and development of air power from dirigibles and balloons to the present; emphasizing evolution of concepts and doctrine governing air power employment in support of national objectives. (May not be counted to satisfy graduation requirements.) Half course. *Spencer*

#### **54. Corps Training.** No course credit. *Staff*

##### **Professional Officer Courses**

All students selected to continue aerospace studies pursue the following courses:

##### *First Year*

#### **104. Corps Training.** No course credit. *Staff*

**105S. Aerospace Leadership and Management.** An introduction to management fundamentals to include the knowledge base and process of managing. One course. *Griffin*

**106S. Aerospace Leadership and Management.** Application of management fundamentals to duties as junior officers/executives to include principles of leadership and military law. One course. *Griffin*

##### *Second Year*

**203. The Problems of Flight and Aerospace Sciences of Weather and Navigation.** Mandatory for pilot cadets; approval of instructor for all others. Half course. *Vesel*

#### **204. Corps Training.** No course credit. *Staff*

**205S. National Security Forces in Contemporary American Society.** Current questions of the role and function of the professional military officer in a democratic society and the complex relationships in civil-military interactions. One course. *Vesel*

**206S. National Security Forces in Contemporary American Society.** Formulation and implementation of American defense policy. One course. *Vesel*

##### **NAVAL SCIENCE**

Professor Hayes, Captain, U.S. Navy, *Chairman*; Visiting Associate Professor Marquis, Commander, U.S. Navy, *Director of Undergraduate Studies*; Visiting Assistant Professors Bell, Major, U.S. Marine Corps; Watkins, Lieutenant, U.S. Navy; Waters, Lieutenant, U. S. Navy

Completion of all naval science courses listed is required for a commission. A maximum of four naval science courses may be offered as electives in satisfying degree requirements in Trinity College; only two naval science courses (junior or senior level) can be so offered in the School of Engineering. Fifteen hours of practical and applied leadership are required each semester.

**11L. Naval Orientation.** Military formations, movements, commands, courtesies, and honors; and elements of unit leadership. *Waters*

**12. Naval Ships Systems.** Structure, elements of design, stability, control compartmentation, communications, and propulsion systems as they bear on safe operation and combat or service effectiveness. One course. *Waters*



**51, 52. Seapower and Maritime Affairs Seminar.** Strategic, tactical, and diplomatic aspects of seapower. *Bell*

**70P. Naval Organization and Management.** Lines of command and control; organization for logistics, service, and support; research on the practical application of fundamental management principles at lower echelons of Navy management structure. (Required preceptorial for NROTC students taking Management Sciences 125.) *Hayes and Marquis*

**126. Concepts and Analyses of Naval Tactical Systems.** Detection systems, offensive and defensive capabilities. One course. *Blount*

**131. Navigation.** Theory, principles and procedures of ship navigation, movements, and employment. Dead reckoning, piloting, and electronic and principles of navigation as presented in the lecture series. Naval Science 131L is a concurrent requirement. One course. *Watkins*

**131L. Navigation Laboratory.** Practical application of the theories and principles of navigation as presented in the lecture series. *Watkins*

**132. Naval Operations.** Components of general naval operations, including concepts and application of tactical formations and dispositions, relative motion, maneuvering board, and tactical plots, rules of the road, and naval communications. Naval Science 132L is a concurrent requirement. One course. *Watkins*

**132L. Naval Operations Laboratory.** Practical application of the theories of naval operations as presented in the lecture series. *Watkins*

**141. Evolution of Warfare.** A survey of the development of weaponry, tactics, and strategy affiliated with warfare, as exemplified by the confrontations selected for detailed study through World War II. One course. *Bell*

**146L. Naval Ship Administration Laboratory.** Management and organizational concepts in shipboard command and control. *Hayes and Marquis*

**151. Amphibious Operations.** An examination of the development of U. S. amphibious doctrine, with emphasis on current applications of that doctrine. One course. *Bell*



## Romance Languages

Professor Tetel, *Chairman*; Assistant Professor Bryan, *Director of Undergraduate Studies in French*; Professor Davis, *Director of Undergraduate Studies in Spanish*; Associate Professor Hull, *Supervisor of Language Instruction*; Professors Cordle, Fein, Fowlie, Niess, Predmore, and Wardropper; Associate Professors Garcí-Gómez, Ripley, Stewart, and Vincent; Assistant Professors Barlow, Caserta, Fielding, Landeira, Miller, and Steegar

French 63, 74, and Spanish 63, 74 or equivalent are the prerequisites for all courses not taught in English. Students who, by reason of foreign residence, have had special opportunities in French or Spanish must be classified by the appropriate Director of Undergraduate Studies.

The intensive language courses 181, 182 are recommended for students who wish to acquire proficiency in a second foreign language before entering graduate school.

In literature, one AP credit is granted for a score of 3 or 4 and two credits for score of 5 (French or Spanish 70, 71). In language one AP credit (French or Spanish 76) is granted for scores 3-5.

### FRENCH

#### Literature in English Translation

**113. Society and the Novel in Modern France.** Social structure and realities in fiction, beginning with the seventeenth century. One course. *Stewart*

**116. The Nineteenth Century Novel.** Stendhal, Balzac, Flaubert, and Zola. One course. *Niess*

**151. Theory and Form of Tragedy.** A study of major theorists and an analysis of principal Greek, French, and English tragedies. (Also listed as Comparative Literature 151.) One course. *Fowlie*

**217. French Symbolism.** (See listing below under French Literature.) *Fowlie*

**223. Structuralism and the New Criticism.** (See listing below under French Literature.) *Fowlie*

**228. French Poetry of the Twentieth Century.** (See listing below under French Literature.) *Fowlie*

**233. Contemporary French Theatre.** (See listing below under French Literature.) *Fowlie*

**234. Proust.** (See listing below under French Literature.) *Fowlie*

#### Language and Civilization

**1-2. Elementary French.** Understanding, speaking, reading, and writing French. Language laboratory available for recording-listening practice. Two courses. *Steegar and Staff*

**63. Intermediate French.** Grammar review; reading; oral practice, including laboratory experience. One course. *Hull and Staff*

**74. Intermediate Readings in Modern French.** Readings, discussion, composition, listening practice. One course. *Hull and Staff*

**76. Introductory French Conversation.** Practice in everyday conversational French. Prerequisite: French 63 or equivalent. Limited to fifteen students. One course. *Staff*

**100. Active French.** Conversation and *exposés* on contemporary subjects. Prerequisite: French 76 or consent of instructor. One course. *Bryan or Staff*

**125. The French of Canada.** The language of the French Canadians: its origins, history, and present status; psycholinguistic and sociolinguistic problems; bilingualism in Canada. Lectures and reports in English; readings in English and French. Prerequisite: French 74 or equivalent, or consent of instructor. One course. *Hull*

**126. French Phonetics.** Sounds, rhythm, intonation. Individual practice in language laboratory. Readings in phonetic theory. One course. *Hull and Steegar*

**127S. Advanced Composition and Conversation.** Prerequisite: French 100. Not open to freshmen. One course. *Bryan*

**128. Advanced Grammar and Translation.** Differences between French and English patterns of expression. Practice in translation. Prerequisite: French 100 or equivalent. Not open to students who have had French 209. One course. *Hull*

**129. Foundations of French Civilization.** Its development up to the Revolution of 1789 in relation to European culture. Readings and discussions in French. One course. *Staff*

**130. Modern French Civilization.** Nineteenth and twentieth-century France, history, institutions, customs, and arts. Readings and discussions in French. One course. *Staff*

**150T. Tutorial in Composition.** Half course. *Barlow or Staff*

**181. Intensive French.** An introduction to the language. Prerequisite: four semesters of another language or consent of instructor. One course. *Ripley*

**182. Intensive French.** Readings in modern literature: analysis and discussion. Prerequisite: French 181 or consent of instructor. One course. *Ripley*

**210. The Structure of French.** Modern French phonology, morphology, and syntax. Readings in current linguistic theory. One course. *Hull*

**224. History of the French Language.** The evolution of French from Latin to its present form; internal developments and external influences. One course. *Hull*

## Literature

**70, 71.** (These numbers represent 1 or 2 course credits for advanced placement in literature.)

**101, 102. Introduction to French Literature.** An introduction to the major writers of the French literary tradition. Selections and complete works of poetry, fiction, theater, and essay. In the first semester: Middle Ages through the eighteenth century. In the second semester: nineteenth and twentieth centuries. Lectures and discussions; short essays and tests. Conducted in French. Two courses. *Fowlie and Staff*

**103S, 104S. French Literature.** Topics to be announced. Open only to freshmen and sophomores. Two courses. *Staff*

**105. Explication de Texte.** A study of the French method of textual analysis, with selections primarily from nineteenth and twentieth century authors. For students who have taken French 101 or 102. One course. *Staff*

**106S. Montaigne.** A close reading of selected *Essais* aiming to integrate themes, structure, and style; frequent comparative allusions will be made to Proust, Pirandello, Malraux, and Sartre. One course. *Tetel*



**107S. Perspectives in Criticism.** Readings and discussions. Open only to freshmen and sophomores through the Advanced Placement Program or by invitation of the Director of Undergraduate Studies. One course. *Stewart*

**108. Romanticism in French Literature.** Romantic theory and novelists including Constant, Stendhal, and Balzac; representative poets and dramatists including Lamartine, Hugo, Musset, and Vigny. One course. *Niess*

**109. Toward Modernism in French Poetry.** An introduction to modern trends in the nineteenth century; emergence from traditional romanticism; Art for Art's Sake and Parnassians (Gautier, Leconte de Lisle); the transition from decadence to symbolism (Baudelaire, Verlaine, Rimbaud, and Mallarmé). One course. *Barlow*

**110. French Comedy in the Seventeenth and Eighteenth Centuries.** The theatrical tradition of comedy and its evolution; readings from Corneille, Molière, Lesage, Marivaux, and Beaumarchais. One course. *Stewart*

**111. French Drama of the Nineteenth Century.** A survey of the French theater from the Romantic period to the *Théâtre libre*. One course. *Staff*

**112. French Drama of the Twentieth Century.** A survey of literature for the stage from 1890 to present. One play each of Claudel, Maeterlinck, Jarry, Giraudoux, Cocteau, Ghelderode, Anouilh, Montherlant, Sartre, Camus, Genet, Ionesco, Beckett, Pinget, Vian, Arrabal. One course. *Cordle or Staff*

**114S. The Sixteenth Century.** An introduction to the spirit of the French Renaissance as reflected in the literature of the age of Rabelais and Montaigne, Ronsard, and du Bellay. One course. *Tetel or Vincent*

**115. Realism and Naturalism in French Literature.** Flaubert, Maupassant, and Zola. One course. *Niess*

**117S. Masterpieces of French Medieval Literature.** Lyric poetry, epic romance, and theater from beginning to the middle French period. One course. *Ripley*

**119. French Drama of the Seventeenth Century.** The plays of Corneille, Racine, and Molière are used to explore tragedy and comedy. One course. *Staff*

**120. Seventeenth Century Poetry, Novel, and Rhetoric.** Analysis of form and thought in selected works of La Fontaine, Mme. de La Fayette, Pascal, La Rochefoucauld, and La Bruyère. One course. *Staff*

**121. The French Enlightenment.** Religion, politics, and philosophic and literary ideas of eighteenth century France: Montesquieu, Voltaire, Rousseau, and others. One course. *Stewart*

**122. The Early French Novel.** The rise of the novel as a literary form up to the Revolution. Readings from D'Urfé, Scarron, Mme. de la Fayette, Furetière, Montesquieu, Prévost, Marivaux, Diderot, Rousseau, Laclos. One course. *Stewart*

**132. French Poetry of the Twentieth Century.** The symbolist heritage and surrealism. One course. *Barlow*

**133, 134. Contemporary French Life and Thought.** Major writers of the twentieth century and their historical and cultural circumstances. First semester: Claudel, Gide, Valéry, Proust, Apollinaire, Mauriac, Alain-Fournier, Cocteau. Second semester: Giono, Breton, Aragon, Malraux, Sartre, Beckett, Camus, Robbe-Grillet, Sarraute. Two courses. *Cordle*



**141S, 142S. French Literature.** Topics to be announced. Open to juniors and seniors. Two courses. *Staff*

**152. André Gide: the Art of Fiction and Autobiography.** Gide's major works and his use of Greek myths with a comparative study of these myths in English and German Literature. Readings in French or English. (Also listed as Comparative Literature 152.) One course. *Fowlie*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors by consent of instructor and the Director of Undergraduate Studies. Two studies. *Staff*

**193, 194. Independent Study.** Directed reading and research. Open only to qualified seniors by consent of the instructor and of the Director of Undergraduate Studies. Two courses. *Staff*

**213, 214. Literature of the Seventeenth Century.** First semester: dramatic literature. Second semester: prose, including the novel and the moralists; baroque and *précieux* poetry. Two courses. (Six graduate units.) *Staff*

**217. French Symbolism.** Poetry and theories of Baudelaire, Mallarmé, and Rimbaud; Decadence; Lautréamont and Laforgue. One course. (Three graduate units.) *Fowlie*

**219. Old French Literature.** An introduction to the reading of medieval French literary texts. One course. (Three graduate units.) *Vincent*

**220. French Pre-Romantic and Romantic Poetry.** Chénier, Vigny, Lamartine, Musset, Hugo, and Nerval. One course. (Three graduate units.) *Neiss*

**221, 222. The Nineteenth-Century French Novel.** First semester: Romanticism and Romantic Realism, studied especially in the works of Chateaubriand, Stendhal, and Balzac. Second semester: Realism and Naturalism, with special emphasis on Flaubert and Zola. Two courses. (Six graduate units.) *Neiss*

**223. Structuralism and the New Criticism.** Backgrounds of the New Criticism and its contemporary practice; psychoanalysis (Jung, Freud); archetypes (Bodkin); existentialism (Sartre); myth and ritual (Frazer, Harrison, etc.); structuralism in anthropology (Levi-Strauss); structuralism in literary criticism (Barthes, Starobinski, Rousset, etc.) To be conducted in English. Readings in English or French. (Also listed as Comparative Literature 223.) One course. (Three graduate units.) *Fowlie*

**225. French Prose of the Sixteenth Century.** Readings principally from Rabelais, Marguerite de Navarre, and Montaigne. One course. (Three graduate units.) *Tetel*

**226. French Poetry of the Sixteenth Century.** A critical appraisal of Villon, Marot, the Ecole Lyonnaise, the Pléiade, and the "Baroque Poets." One course. (Three graduate units.) *Tetel*

**228. French Poetry of the Twentieth Century.** In the wake of symbolism; Valéry and Claudel; poetry as ritual, Peguy; Apollinaire and surrealist poetry. the contemporary movement: Michaux, Char, Saint-John Perse. One course. (Three graduate units.) *Fowlie*

**233. Contemporary French Theatre.** A study of dramatic theory; the art of the leading directors; and the major texts of Claudel, Giraudoux, Anouilh, Sartre, Beckett, Ionesco, and Genet. One course. (Three graduate units.) *Fowlie*

**234. Proust.** A study of *A la recherche du temps perdu*. The thematic structure and the aesthetics of the work. One course. (Three graduate units.) *Fowlie*

**241, 242. French Literature of the Eighteenth Century.** First semester: the Enlightenment, including Montesquieu, Voltaire, Diderot, Rousseau, and the *Encyclopédie*. Second semester: the development of literary forms, with emphasis on the theater and the novel. Two courses. (Six graduate units.) *Stewart*

**245, 246. French Literature of the Twentieth Century.** First semester: to 1935, emphasis on Gide, Mauriac, and Malraux. Second semester: after 1935, emphasis on Sartre, Camus, and the *nouveau roman*. Two courses. (Six graduate units.) *Cordle*

## ITALIAN

### Literature in English Translation

**141, 142. Masterworks of Italian Literature.** First semester: from the origins to the Baroque. Second semester: Ottocento and Novecento. Two courses. *Caserta*

**284. Dante.** (See listing below under Italian Literature.) *Fowlie*

**285. Dante.** The *Purgatorio* and the *Paradiso* in the light of Dante's cultural world. Special attention will be given to the poetic significance of the *Commedia*. Prerequisite: Italian 284 or equivalent. One course. *Caserta*

### Language and Civilization

**1-2. Elementary Italian.** Understanding, speaking, reading, and writing Italian. Language laboratory available for recording-listening practice. Two courses. *Caserta and Staff*

**63. Intermediate Italian.** Grammar review; reading; oral practice, including laboratory experience. One course. *Caserta and Staff*

**74. Intermediate Readings in Modern Italian.** Readings, discussion, composition, listening practice. One course. *Caserta and Staff*

**100. Spoken Italian.** Intensive instruction in contemporary Italian using selected topics and readings to build vocabulary and to provide practice in structural patterns. One course. *Caserta*

**129. Modern Italy.** Political, social, economic, and cultural problems in Italian history from 1861 to the present day. One course. *Caserta*

**181. Intensive Italian.** An introduction to the language. Prerequisite: four semesters of another foreign language or consent of instructor. One course. *Caserta*

### Literature

**182. Intensive Italian.** Readings in modern literature: analysis and discussion. Prerequisite: Italian 181 or consent of instructor. One course. *Caserta*

**183, 184. Readings in Italian Literature.** Historical and critical analysis. First semester: Dante, Petrarch, Boccaccio, and the Humanists. Second semester: Foscolo, Manzoni, Leopardi, and Verga. Conducted in Italian. Two courses. *Caserta*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors by consent of instructor and of the Director of Undergraduate Studies. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research. Open only to

qualified seniors by consent of instructor and the Director of Undergraduate Studies. Two courses. *Staff*

**283. Italian Novel of the Novecento.** Representative novelists from Svevo to the most recent writers. One course. (Three graduate units.) *Caserta*

**284. Dante.** *La Vita Nuova* and a close reading of the *Inferno*. Conducted in English. Reading in Italian or English. One course. (Three graduate units.) *Fowlie*

**285. Dante.** The *Purgatorio* and the *Paradiso* in the light of Dante's cultural world. Special attention will be given to the poetic significance of the *Commedia*. Prerequisite: Italian 284 or equivalent. One course. *Caserta*

**288. The Renaissance.** Petrarch, Boccaccio, and Ariosto. One course. (Three graduate units.) *Tetel*

## PORTUGUESE

### Language and Civilization

**181. Brazilian Portuguese.** An intensive introduction to the language. Prerequisite: four semesters of another foreign language or consent of instructor. One course. *Miller*

**185, 186. Conversation.** Practice in spoken Brazilian Portuguese. Prerequisite: Portuguese 182 or consent of instructor. Two courses. *Miller*

### Literature

**182. Contemporary Brazilian Theater.** Authors studied include Jorge Andrade, Ariano Suassuna, and Dias Gomes. Prerequisite: Portuguese 181 or consent of instructor. One course. *Miller*

**183. Readings in Modern Brazilian Literature.** Prerequisite: Portuguese 182 or consent of instructor. One course. *Miller*

**184. Literature of the Explorations: Asia, Africa, Latin America.** Prerequisites: Portuguese 182 or consent of instructor. One course. *Miller*

**191, 192. Independent Study.** Directed reading and research. Prerequisite: junior standing and consent of instructor and Director of Undergraduate Studies. Two courses. *Miller*

**193, 194. Independent Study.** Directed reading and research. Prerequisite: senior standing and consent of instructor and Director of Undergraduate Studies. Two courses. *Miller*

## SPANISH

### Literature in English Translation.

**152. Modern Mexico.** (See listing below under Spanish Language and Civilization.) *Fein and TePaske*

**157. Latin American Literature.** Fictional and poetic works of the last thirty years that have made an impact on world literature. One course. *Fein*

### Language and Civilization

**1-2. Elementary Spanish.** Understanding, speaking, reading, and writing Spanish. Language laboratory available for recording-listening practice. Two courses. *Miller and Staff*

**63. Intermediate Spanish.** Grammar review; reading; oral practice, including laboratory experience. One course. *Davis and Staff*

**74. Intermediate Readings in Modern Spanish.** Discussion, composition, listening practice. One course. *Davis and Staff*

**76. Introductory Spanish Conversation.** Practice in everyday conversational Spanish. Prerequisite: Spanish 63 or equivalent. Limited to fifteen students. One course. *Garci-Gómez and Staff*

**100. Active Spanish.** Conversation and written expression emphasizing oral communication. Prerequisite: Spanish 76 or consent of instructor. Limited to fifteen students. One course. *Garci-Gómez or Staff*

**105. Spanish in Medicine and Nursing.** Introduction to medical language situations emphasizing oral communication. Prerequisite: Spanish 76 or consent of instructor. One course. *Garci-Gómez*

**150T. Tutorial in Composition and Syntax.** Half course. *Staff*

**152. Modern Mexico.** A problem-oriented, interdisciplinary approach based on literature, history, the fine arts, and films. Readings in English or Spanish. (Also listed as History 152.) One course. *Fein and TePaske*

**153S, 154S. Spanish Language: Peninsular or American.** Topics to be announced. Two courses.

**164. Topics of Spanish Civilization.** A humanistic study of Spain as a nation through its history, culture, people, and institutions. One course. *Landeira*

**176S. Advanced Conversation.** This course is designed to develop facility of expression through constant drill on vocabulary and conversational idiom. Prerequisite: Spanish 100 or consent of instructor. One course. *Landeira or Staff*

**177. Advanced Composition.** Writing idiomatic Spanish: emphasis on topics in literature, law, business, and government. Prerequisite: Spanish 176 or consent of instructor. One course. *Davis or Garci-Gómez*

**181. Intensive Spanish.** An introduction to language. Modern readings. Prerequisite: four semesters of another foreign language or consent of instructor. One course. *Miller*

**182. Readings in Spanish American Literature.** Prerequisite: Spanish 181 or consent of instructor. One course. *Miller*

**257. Old Spanish Language.** The historical development of the language. Illustrative readings. One course. (Three graduate units.) *Davis or Garci-Gómez*

**259. Spanish Phonetics.** A phonemic approach to the study of Spanish sounds. Remedial pronunciation drills with special emphasis on rhythm and intonation. Readings in current studies of phonology. Prerequisite for undergraduates: Spanish 176 or consent of instructor. One course. (Three graduate units.) *Predmore*

## Literature

**70, 71.** (These numbers represent 1 or 2 course credits for advanced placement in literature.)

**101, 102. Introduction to Literature and Civilization.** Literature, art, and history. First semester: Middle Ages through eighteenth century. Second semester; nineteenth and twentieth centuries. Two courses. *Garci-Gómez and Landeira*



**103S, 104S. Peninsular or Spanish-American Literature.** Topics to be announced. Open only to freshmen and sophomores. Two courses. *Staff*

**117S. Spanish Traditional Poetry.** The Spanish *Romancero*; ballads and other forms of popular poetry. One course. *Garcí-Gómez*

**141S, 142S. Spanish Literature.** Topics to be announced. Open to juniors and seniors. Two courses. *Staff*

**155. Spanish American Short Fiction.** Novelettes and short stories of the twentieth century. One course. *Fein*

**156. The Spanish American Novel.** Masterworks of the nineteenth and twentieth century. One course. *Fein*

**161. Spanish Literature of the Renaissance and the Baroque.** Selected works of the sixteenth and seventeenth centuries with attention to their reflection of social, religious, and political ideas. One course. *Miller and Wardropper*

**162. Spanish Romanticism.** A study of the romantic spirit in modern Spanish literature. One course. *Davis or Landeira*

**163. The Generation of 1898.** Special emphasis on the novel and essay. The precursors: "Clarín" and Gánivet; Unamuno, Baroja, "Azorín," Valle-Inclán; influence on the next generations; Pérez de Ayala and Ortega y Gasset. One course. *Landeira or Predmore*

**165S. Major Spanish Authors.** Textual studies; methods of literary interpretation and criticism. One course. *Wardropper*

**166. Spanish Realism.** The growth of realism in Spanish literature of the nineteenth century. One course. *Davis*

**167. Golden Age Literature: Cervantes.** Emphasis on the *Quijote*. One course. *Predmore*

**169. Literature of Contemporary Spain.** Trends in the post-Civil War novel, theater, and poetry. One course. *Landeira*

**170. The Picaresque Novel.** One course. *Garcí-Gómez*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified juniors by consent of instructor and Director of Undergraduate Studies. Two courses.

**193, 194. Independent Study.** Directed reading and research. Open only to qualified seniors by consent of instructor and Director of Undergraduate Studies. Two courses.

**251. The Origins of Spanish Prose Fiction.** Selected examples of the principal genres of the romance and the novel: *Amadís de Gaula*, Diego de San Pedro's *La carcel de amor*, the *Abencerraje*, the *Lazarillo*, Montemayor's *Diana*. One course. (Three graduate units.) *Wardropper*

**252S. Spanish Lyric Poetry Before 1700.** Selected poems of the Middle Ages, Renaissance, and Baroque. Special emphasis on the *Razón de amor*, *la poesía de tipo tradicional*, and *Santillana*; on Garcilaso, San Juan de la Cruz, Fray Luis de Leon, and Herrera; on Gongora and Quevedo. One course. (Three graduate units.) *Wardropper*

**253. The Origins of Spanish Theatre.** Evolution of the Spanish theater from the *Auto de los Reyes Magos* (twelfth century) to the end of the sixteenth century. The idea of the theater as dramatic poetry will be stressed; close reading texts

by Gómez Manrique, Encina, Gil Vicente, Torres Naharro, Lope de Rueda, Juan de la Ceuva. One course. (Three graduate units.) *Wardropper*

**255, 256. Modern and Contemporary Spanish American Literature.** First semester: poetry from *Modernismo* to the present. Second semester: twentieth century fiction. Two courses. (Six graduate units.) *Fein*

**258. Medieval Literature.** An introduction to medieval Spanish texts. One course. (Three graduate units.) *Davis or Garci-Gómez*

**260. Origins and Development of Spanish Romanticism.** Representative authors, including Espronceda, Rivas, Zorilla, Bécquer, and Rosalía de Castro, with a stress on drama and poetry. One course. (Three graduate units.) *Landeira*

**261. Nineteenth Century Novel.** A study of literary trends in the last half of the nineteenth century. Readings will be selected from the novels of Valera, Pereda, Galdós, Pardo Bazán, Blasco Ibáñez, and their contemporaries. One course. (Three graduate units.) *Davis*

**262. Galdós.** Works selected from the *Novelas contemporaneas*, *The Episodios nacionales*, and his drama. One course. (Three graduate units.) *Davis*

**265. Cervantes.** The life and thought of Cervantes with special emphasis on his *Quijote*. One course. (Three graduate units.) *Predmore or Wardropper*

**266. Drama of the Golden Age.** The chief Spanish dramatists of the seventeenth century with readings of representative plays of this period. One course. (Three graduation units.) *Wardropper*

**275, 276. Contemporary Spanish Literature.** First semester: the essay and lyric poetry. Revision of national values and literary expression in the twentieth century, with particular reference to the crisis of 1898 and to the enrichment of the Spanish tradition through extra-peninsular influences. Second semester; tradition and innovation in the twentieth-century Spanish novel with emphasis in the novels of Unamuno, Baroja, Valle Inclán, and Pérez de Ayala. Two courses. (Six graduate units.) *Predmore*

## ROMANCE LANGUAGES

### Literature in English Translation

**124. Continental Humanism.** Readings from Boccaccio, Petrarch, Rabelais, Montaigne, Rojas, Cervantes, and Erasmus. (Also listed as Comparative Literature 124.) One course. *Tetel*

**160. An Approach to Comedy.** Nature, purpose, and effect of comedy in the theater. Readings from the classics (Aristophanes, Plautus, Terence), the Renaissance (Machiavelli, Shakespeare, Molière, Lope de Vega), the Restoration and the twentieth century. (Also listed as Comparative Literature 160.) One course. *Wardropper*

### Language

**218. The Teaching of Romance Languages.** Evaluation of objectives and methods; practical problems involved in teaching these languages on the elementary, secondary, and college level; analysis of textbooks, special foreign language programs, audiovisual aids, and tests. One course. (Three graduate units.) *Hull*

## DEPARTMENTAL MAJOR

*Prerequisite.* French or Spanish 74 or proficiency.

*Major Requirements.* Literature Major: a total of eight courses (above 76), no fewer than five literature courses, and no fewer than two language courses. The literature courses must represent at least three of the six historical periods, (medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth centuries for French; and medieval, Renaissance, seventeenth, eighteenth, nineteenth, twentieth centuries, and Spanish-American for Spanish).

*Language Major.* A total of eight courses, no fewer than four language courses. (for French, from 100, 126, 127, 128, 129, 130, 150T, 210, 224; for Spanish, from 100 or 105, 150T, 153S, 154S, 176S, 177, 257, 259) and no fewer than two literature courses.

*Study Abroad.* No more than two courses per semester and one course per summer count toward the major.

In order to give perspective to a student's program, majors in Romance Languages will normally select, with the approval of the major adviser, appropriate courses from such fields as: (1) other languages and literature; (2) history; (3) philosophy; (4) appreciation courses in music and art; and (5) linguistics.

## Slavic Languages and Literatures

Professor Krynski, *Chairman*; Associate Professor Jezierski, *Director of Undergraduate Studies and Supervisor of Language Instruction*; Assistant Professor Shonek; Lecturer Sagatov

**1, 2. Elementary Russian.** Introduction to understanding, speaking, reading, and writing. Audiolingual techniques are combined with required recording-listening practice in the language laboratory. Two courses. *Staff*

**63, 64. Intermediate Russian.** Intensive classroom and laboratory practice in spoken and written patterns. Reading in contemporary literature. Prerequisite: Russian 1, 2, or two years of high school Russian. Two courses. *Staff*

**101, 102. Russian Literature and Culture Through the Nineteenth Century.** Prose, poetry, and drama with special attention to later periods. Readings in English (from *The Igor Tale* to *Blok*). Two courses. *Jezierski*

**105. The Russian Theatre and Drama.** Russian drama from its beginnings to the present. Readings in English or Russian. One course. *Jezierski*

**119. Introduction to Russian Literature of the Nineteenth Century.** Conducted in Russian. Prerequisite: Russian 63, 64 or equivalent. One course. *Sagatov*

**120. Introduction to Russian Literature of the Twentieth Century.** Conducted in Russian. Prerequisite: Russian 119. One course. *Sagatov*

**119P, 120P. Preceptorial.** Elective preceptorials for students enrolled in Russian 119, 120. *Sagatov*

**124. Masters of Russian Short Fiction.** Pushkin, Gogol, Turgenev, Tolstoy, Dostoevsky, Chekhov, Babel, and others. Readings in English. One course. *Jezierski*

**161. Introduction to the Russian Novel.** Outstanding works of Lermontov, Gogol, Turgenev, Goncharov, Tolstoy. Readings in English. One course. *Krynski*

**162. Introduction to the Russian Novel.** Outstanding works of Dostoevsky, Bely, Solugub, Bunin, Gorky. Readings in English. One course. *Krynski*

**173. The Slavs: Literature and Culture, 1918-1939.** Culture of the Soviet Union, Poland, and Czechoslovakia; representative literary masterpieces. Comparison with Western European trends. Readings in English. (Also listed as Comparative Literature 173.) One course. *Krynski*

**173P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literatures 173. *Krynski*

**174. The Poles: Literature and Culture, 1940-1970.** Culture of Poland; representative literary masterpieces. Emphasis on Western literary avant-garde and Soviet political influences; Jewish themes. Readings in English. (Also listed as Comparative Literature 174.) One course. *Krynski*

**174P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Language and Literatures 174. *Krynski*

**175S. Leo Tolstoy.** Introduction to life and works. Readings in English will include *War and Peace*, *Anna Karenina*, the shorter fiction, dramatic works, and essays. Tolstoy's impact on the literature and thought of today, in and outside of Russia. One course. *Jezierski*

**176. Fyodor Dostoevsky.** Introduction to life and works. Emphasis on his relevance to today's world. Readings in English of major works; close study of *Crime and Punishment*, *The Idiot*, and *The Brothers Karamazov*. Historical overview of critical reaction in Russia and abroad. One course. *Jezierski*

**177. Introduction to the World of Chekhov.** Close scrutiny of selected prose and dramatic works of a Russian precursor of the modern sensibility. Readings in English. One course. *Jezierski*

**177P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literatures 177. *Jezierski*

**179. Twentieth Century Russian Prose.** Modern prose in the original. Textual analysis of Russian prose since the turn of the century. Prerequisite: Russian 1, 2, 63, 64, or consent of instructor. One course. *Krynski*

**183. Slavic Drama and Theatre of the Twentieth Century.** Russian, Polish, and Czech plays from the beginning of the century through the mid-seventies: Chekhov, Mayakovsky, Evreinov, Witkiewicz, Gombrowicz, Mrozek, Rozewicz, and Capek. Theatrical theories of Meyerhold, Vakhtangov, Tairov, Grotowski, and others. Slavic avant-garde developments, especially of the last two decades, in the context of Western European "theatre of the absurd." Readings in English, or, if qualified, in Russian or Polish. One course. *Krynski*

**184. The Jews in Russian and Polish Literature Since 1917.** Jewish themes and protagonists in the works of leading writers of Russia and Poland, both Jewish and non-Jewish. Historical background of Jews and their role in the early stages of the Revolution and the dissident movement after Stalin's death. Readings in English, or if qualified, in Russian or Polish. One course. *Krynski*

**185. Vladimir Nabokov.** The Russian and English novels, short fiction, plays, poetry, and criticism of Vladimir Nabokov. Readings in English. Qualified students may do some readings in Russian. One course. *Jezierski*

**186. Non-Russian Slavic Literatures.** Selected Polish, Czech, Serbian, Croatian, and Bulgarian authors, from the beginnings to recent times. Readings in English. (Also listed as Comparative Literature 186.) One course. *Jezierski*

**188. Solzhenitsyn and the World of Soviet Concentration Camps.** The major



works of Alexander Solzhenitsyn with emphasis on concentration camp writings. Background readings by other authors and scholars, Russian and Western. One course. *Krynski*

**191, 192. Independent Study.** Directed reading and research. Open only to qualified students by consent of Director of Undergraduate Studies. Two courses. *Staff*

**193, 194. Independent Study.** Directed reading and research for qualified seniors. Prerequisite: consent of Director of Undergraduate Studies. Two courses. *Staff*

**195. Advanced Russian.** Review of grammar with an emphasis on the refinement of oral and written language skills. Prerequisite: Russian 120 or consent of instructor. One course. *Sagatov*

**196. Readings in Modern Russian.** An intensive reading-conversation course based on contemporary Russian literary and Soviet press texts, emphasizing problems in Russian-English and English-Russian translation. Prerequisite: Russian 195 or consent of instructor. One course. *Sagatov*

### For Seniors and Graduates

**201, 202. Russian Novel of the Nineteenth Century.** First semester: 1830-1870. Second semester: 1870-1900. Prerequisite 161, 162 or equivalent. Two courses. (6 graduate units.) *Krynski*

**205. The Structure of Polish in Relation to Russian.** Comparative and contrastive study of the two major Slavic languages. Emphasis on preparing students to read Polish literary texts. One course. (3 graduate units.) *Krynski*

**206. Readings in Contemporary Polish Prose in the Original.** Stylistic analysis of aphoristic prose by Stanislaw Lec, philosophical allegories by Leszek Kolakowski and short stories by Slawomir Mrozek and Marek Hlasko. One course. (3 graduate units.) *Krynski*

**207. Soviet Literature and Culture.** Literature since 1917. Readings in English from major works of prose, poetry, and drama. One course. (3 graduate units.) *Jezierski*

**207P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literatures 207. *Jezierski*

**212. Pushkin.** Survey of life and works, his role as precursor of modern Russian literature. Readings in English and Russian. Prerequisite: Russian 101 or consent of instructor. One course. (3 graduate units.) *Krynski*

**225S. Tolstoy.** *War and Peace* and other works. Prerequisite: Russian 175S or equivalent. One course. (3 graduate units.) *Jezierski*

**227S. Gogol.** Life and works: short stories, dramas, and the novel. Readings in English or Russian. One course. (3 graduate units.) *Jezierski*

**230. Chekhov.** Structural analysis of Chekhov's short stories and plays against the background of contemporary Realist, Impressionist, and Decadent trends in Russian literature. One course. (3 graduate units.) *Jezierski*

**230P. Preceptorial.** Elective preceptorial for students enrolled in Slavic Languages and Literature 230. *Jezierski*

**232. Dostoevsky.** Emphasis on *Brothers Karamazov* and the theory of the novel. Prerequisite Russian 176, or equivalent. One course. (3 graduate units.) *Jezierski*

**236. Russian and Polish Romanticism.** Prose, poetry, and drama of such major writers as Pushkin, Lermontov, Mickiewicz, and Krasinski presented against the background of the Romantic movement in Western Europe. One course. (3 graduate units.) *Krynski*

## DEPARTMENTAL MAJOR

*Prerequisites.* Russian 1, 2 and 60, 64, or equivalent.

*Major Requirements.* A minimum of eight courses in the department. All majors must take the following courses: Russian 91, 92, 195, 196, plus four courses in literature, two of which must be selected from 200-level courses.

Students contemplating graduate work may elect a more intensive program consisting of ten courses. A knowledge in depth of Russian literature or some knowledge of Polish language and/or literature will facilitate admission to graduate school and subsequent study in the field.

## Sociology

Professor Kerckhoff, *Chairman*; Associate Professor House, *Director of Undergraduate Studies*; Professors Back, Maddox, McKinney, Myers, Palmore, Portes, Preiss, Roy, Smith, and Tiryakian; Associate Professors Simpson and Wilson; Assistant Professors Baldigo, Campbell, Evers, Hirschman, and Rice

Understanding the nature of social relationships, groups, and organizations is essential to humane and rational action in an increasingly complex world. The Department of Sociology attempts to impart such understanding as one element of a liberal education. Undergraduate work in sociology, as in the other arts and sciences, does not prepare students for a specific vocation, but it is useful and adequate preparation for either employment or graduate study in any of the following areas: sociology and other social sciences, business, government and public service, and the professions of education, law, medicine, or social work.

The department and its offerings represent the diversity of topics and approaches in sociology, while also offering more concentrated work in certain areas, including deviant behavior (courses 120-123), population and ecology (141, 145, 243), family, sex roles, and socialization (149, 150, 152, 272, and 278), and others. In the major and in many courses, emphasis is placed on learning how to do sociology as well as on studying what others have done. Active involvement in the learning process is also fostered through seminar courses, independent study, honors work, and internship or fieldwork experiences. The department both offers internship courses and encourages students to arrange individual internship experiences for which they receive independent study credit if the internship is coordinated with related academic study.

To provide a variety of educational experiences for the beginning student of sociology, the introductory course, Introduction to Sociology, has a variety of structures. In each, however, students learn basic approaches of sociology to social reality and some of the problems involved in observing, describing, and analyzing facets of social life.

**91. Introduction to Sociology.** Sections of limited enrollment (about 35-50) One course. *Staff*

**91D. Introduction to Sociology.** Two lectures and one discussion section (no more than 20 students per section). One course. *Staff*

**91S. Introduction to Sociology.** Taught as a seminar, enrollment limited to 20 per class. One course. *Staff*

**101. Contemporary American Society.** Social trends and social problems and their effects on individuals and society. Urbanization; bureaucracy; distribution of wealth, income, and power; status of minorities. One course. *Baldigo or House*

Sociology 120, 121, 122 are designed as a sequence, and might optimally be taken in that order, with Sociology 120 being recommended preparation for 121, 122, and 123. However, there are no required prerequisites.

**120. Perspectives on Deviant Behavior.** Development and distribution of deviant social behavior, treating such topics as social disorganization, stress and strain, cultural and labeling theories in relation to crime and delinquency, drug addiction, homosexuality, suicide, or others. (Not open to students who have taken Sociology 143.) One course. *Preiss or Rice*

**121. Law Enforcement and Judicial Systems.** Treatment of deviant behavior by police, prosecutors, and courts. Problems of justice, efficiency, and ethics, Cross-cultural comparisons. One course. *Preiss or Rice*

**122. Punishment and Treatment of Deviants.** Concepts of punishment and rehabilitation. Programs and facilities for deviants. Structure and operation of "total" institutions, such as prisons and hospitals. Problems of returning to family and community life. One course. *Preiss or Rice*

**123. Social Aspects of Mental Illness.** Theoretical and practical sociological contributions to problems of etiology, definition, law and treatment; comparisons with other contributions; questions of public policy and programs. One course. *Back, Baldigo, or Preiss*

**131. Social Change.** Evolutionary and revolutionary changes in political, economic, and social institutions and in social consciousness. Major theories, means of measurement, and sources of innovation. *Hirschman or Tiryakian*

**132. Introduction to Sociological Research.** Observation, measurement, analysis, and methods of presenting research findings. One course. *Evers, Hirschman, or Rice*

**136. Sociology of Modern Africa.** An introduction to the modernization of sub-Saharan Africa. Primary emphasis given to the nature and formation of colonial society, as well as to the process of decolonization and its sources. One course. *Tiryakian*

**139. Comparative Social Structure.** Comparison of social phenomena in two or more societies. Sociological propositions, tested with American data and data from other societies. One course. *Portes or Wilson*

**141. Population and Ecology.** Relation of fertility, mortality, and migration to social development, population composition, and distribution. One course. *Evers, Hirschman, or Myers*

**142. The Sociology of Mass Communication.** An analysis of the role of radio, the press, magazines, movies, and television in modern societies. An examination of the selective audiences, content characteristics, controlling elements, and organizational structure of the various media of mass communication. Comparative Canadian material considered where feasible. One course. *Smith*

**144. Political Sociology.** Politics as social behavior involving change in institutions and structures; current national and local issues. One course. *House, Portes, or Preiss*

**145. Urban Sociology.** Historical, demographic, and ecological materials are used to study urban society with respect to its institutions, interaction patterns, differentiation, integration, disorganization, and decentralization. Comparative Canadian material considered where feasible. One course. *Myers, Portes, or Smith*

**146. Industry and Society.** A study of the community and organizational life of industrial and white-collar workers in relation to the changing institutions of modern society. One course. *Roy*

**147. The Black in the City.** A comparative analysis of the situations and experiences of Black people in urban settings with attention to class, caste, ethnic, social, and racial factors. (Also listed as Black Studies 147.) One course. *Staff*

**149. Sex Roles and Society.** Nature and acquisition of sex roles. Cross cultural variations. Developing nature of sex roles in American society. One course. *Baldigo*

**150. The American Family.** The American family as an institutionalized group and its relationship with other institutions; the social psychology of family relations; variations by social class and ethnic group. One course. *Baldigo, Kerckhoff, Roy, or Simpson*

**151. Sociology of Religion.** The religious factor in modern society and the social factor in modern religion. Major sociological theories and marginal religious groupings. One course. *Tiryakian or Wilson*

**152. Sociology of Education.** Structure and operation of formal educational institutions in Western society and their effects on the social structure. Equality of opportunity, family-school, community-school, student-school relations, and peer influences in the school. One course. *Campbell, Kerckhoff, or Roy*

**154. The Sociology of the Arts.** An analysis of the social relations of the world of the arts (painting and sculpture, music, and literature) with emphasis upon creative artists, art publics, art organizations, and art works as they function in their social-cultural milieu. One course. *Back or Tiryakian*

**155. Sociology of Work.** Study of social organizations of work activities, of the human experiences and group relationships involved. Special focus on management-employee conflict and cooperation. One course. *Roy*

**156. The Contemporary Woman: History and Prospects.** (Also listed as Interdisciplinary Course 156.) Half course. *Staff*

**159. Black and White Relations in America.** The history and changing nature of interaction between Blacks and Whites, including the sources and consequences of discrimination, integration, and Black power. One course. *Staff*

**160. Minorities and Work.** Work and careers of minorities in relation to structures that limit their free movement in the labor force. One course. *Simpson*

**172. Collective Behavior.** Rumor and contagion as general processes; collective expression such as riots, protests, and behavior in disaster. Focus on contemporary Western society. One course. *Portes or Kerckhoff*

**173. Social Movements.** Social movements as agents of change. Structure and development of protest groups. One course. *Wilson*

**184. Canada: Problems and Issues of an Advanced Industrial Society.** (Also listed as Interdisciplinary Course 184.) *Preston and Visiting Lecturers*



**185, 186. Junior Tutorial.** Prerequisite: Sociology 91 (or 91D or 91S) or consent of Director of Undergraduate Studies. Half course each semester. *Staff*

**193, 194. Independent Study.** Prerequisite: consent of instructor. Two courses. *Staff*

**195S, 196S, 197S, 198S. Seminar in Special Topics.** Four courses. *Staff*

### For Graduates and Seniors

**225. Medical Sociology.** Current issues in the organization, development and the utilization of resources for health care. One course. (3 graduate units.) *Back or Maddox*

**230. Social Aspects of Aging and Death.** Theories of human aging; social problems caused by increased longevity, discrimination against the aged, retirement, widowhood, and other role losses. Social-psychological factors in mortality, accidental death, suicide, and murder. One course. (3 graduate units.) *Palmore*

**241. Social Stratification.** The nature of hierarchical and vertical differentiation for the economic, political, and prestige structures in modern societies. The interrelationship of class, status, and power strata and their influence on social institutions, personality structure, and group and individual behavior. The transmission of inequality from one generation to the next. One course. (3 graduate units.) *Campbell, Evers, or Roy*

**242. The Sociology of Occupations and Professions.** The social significance of work. Analysis of forces changing the contemporary occupational structure, typical career patterns of professions and occupations, and social organization of occupational groups. One course. (3 graduate units.) *Roy or Simpson*

**243. Population Dynamics and Social Change.** Social scientific aspects of the determinants and consequences of population trends. One course. (3 graduate units.) *Evers, Hirschman, or Myers*

**244. Human Ecology and Urban Systems.** Origins and development of human ecology theory, growth of cities and urban systems, residential segregation of social classes and racial and ethnic groups. One course. (3 graduate units.) *Evers, Hirschman, Myers, or Smith*

**246. Population Policy.** Formation, effect, and evaluation. Historical examples of mortality, fertility, migration, and distribution policies. The Malthusian and neo-Malthusian controversies. Psychological, sociological, demographic, and political background. (Also listed as Public Policy Science 246.) One course. (3 graduate units.) *Back*

**251. The Sociology of Modernization.** Theories and perspectives on the nature of modernization and modernity in Western and non-Western countries. One course. (3 graduate units.) *Hirschman, Portes, or Tiryakian*

**255. Race and Culture.** A comparative study of race relations in world perspective developed around such themes as race and personal identity, the geography and ecology of race relations, the idea of race, and race conflict. One course. (3 graduate units.) *Hirschman*

**259. Religion and Social Change.** The role of religion in significant social changes in Western and non-Western societies; noninstitutional phenomena (charisma, prophecy, messianism, revivals, glossolalia). One course. (3 graduate units.) *Tiryakian or Wilson*

**260. Science, Technology, and Society.** Science as a social phenomenon. Relations of science to technology and their articulation through public policy. Interaction of the institutions of science with other societal institutions. One course. (3 graduate units.) *McKinney*

**261. Science, Politics, and Government.** The structure and values of the scientific community, the mechanism and strategies of government, and their mutual interdependence in American society. (Also listed as Public Policy Science 255 and Psychology 261.) One course. (3 graduate units.) *Bevan or McKinney*

**272. The Socialization Process.** Mechanisms and variations in socialization by position in the social structure (class, race, urban-rural); contributions made by various socialization agencies (family, school, peer groups, mass media) in Western society. One course. (3 graduate units.) *Baldigo and Kerckhoff*

**275. Social Structure and Personality.** Processes by which social structures and social change (including class, modernization, societal, and organizational membership) affect individual attitudes and behaviors. Nature and effect of stress, alienation, and other forms of incongruence between individuals and social structures. One course. (3 graduate units.) *House or Portes*

**276. Small Groups and Social Life.** A systems theoretical approach. Basic group processes including communication, integration, sub-group formation, specialization, hierarchy, and leadership; different types, contexts and inter-relations of groups. One course. (3 graduate units.) *Back*

**278. Social Structure and the Life Cycle.** Relationship between age as a social characteristic and social interaction, with particular reference to adolescence and old age. One course. (3 graduate units.) *Maddox*

**281. Development of Sociological Theory.** Development, convergence, and utilization of sociological theories. One course. (3 graduate units.) *Tiryakian or Wilson*

**291. Research Methods and Techniques I.** Principles and methods of collecting and utilizing questionnaire and survey data. Application of methods in secondary analysis, laboratory and field experimentation, observation and other types of research. Prerequisite: Sociology 132 or 293 or equivalent. One course. (3 graduate units.) *Evers, House, Portes, or Smith*

**292. Research Methods and Techniques II.** Principles, methods and applications of depth interviewing, participant observation, content and analysis, unobtrusive measures, historical and archival analysis. Issues of reliability, validity, quantification, multiple methodologies, and the interrelationship of theory and method. One course. (3 graduate units.) *Baldigo or Roy*

**293. Introductory Statistical Analysis.** Basic descriptive statistics, regression and correlation, t-tests and the analysis of variance, chi square techniques, and other topics. Stress on practical applications. Statistical computing using SPSS and other programs. One course (3 graduate units.) *Campbell*

**294. Intermediate Statistical Analysis.** The general linear model and its application in methods of multivariate statistical analysis: analysis of variance and co-variance, multiple regression and path analysis, and log-linear models for categorical data. Statistical computing using SPSS and other programs. Prerequisite: Sociology 293 or equivalent. One course. (3 graduate units.) *Campbell or Rice*

**295. Methodology in Sociology.** The nature of scientific method, as well as

alternative paths to knowledge, as they apply to sociology. Conceptualization, hypothesis formation, and definition. The research process as a decision-making situation for both general research design and specific techniques. The process and logic of data analysis. Relations of theory and research are stressed. One course. (3 graduate units.) *Back or Smith*

**298S, 299S. Seminar in Selected Topics.** Substantive, theoretical, or methodological topics. Two courses. (3 graduate units per semester.) *Staff*

## DEPARTMENTAL MAJOR

*Prerequisite.* Sociology 91.

*Major Requirements.* Seven courses in the department above 91, including Sociology 132 and either one 200-level course or one senior seminar.

A sociology major normally takes at least four related courses in the following departments: anthropology, economics, education, history, mathematics, political science, or psychology.

*Honors.* Qualified majors are encouraged to undertake work leading to graduation with distinction. A major with a *B+* average in sociology and a *B* average in all courses is eligible, though the Director of Undergraduate Studies may waive this requirement in special cases. To receive departmental honors a major must complete a paper involving significant independent research or scholarship and pass an oral examination on the paper conducted by a three-person committee, at least two of whom, including the chairman, must be members of the department. Normally, students will prepare the paper over the course of the senior year, working in close collaboration with their chairman and committee, and receiving on the average two course credits in independent study.

## Statistics

Statistics courses offered in several departments at Duke are classified according to function (Tracks) and level as follows: Track 1 includes statistical inference courses for nonstatisticians; Track 2, statistical inference courses for statisticians; Track 3, stochastic processes courses; and Track 4, stochastic communications theory courses. Within each track, courses are classified by level according to the amount of prerequisite statistical knowledge needed. First-level Track 1 courses, which are basic statistics courses for nonstatisticians, cover a certain core curriculum and have no formal statistical prerequisites. For further information on the statistics courses see *Statistics at Duke*, which is available on request from the Department of Mathematics.

## University Courses

University courses are offered by senior named professors. They are electives for juniors and seniors in a form free from ordinary class restrictions.

**199S.1. Current Political Problems in Western European and Commonwealth Countries.**

## Zoology

Professor Fluke, *Chairman*; Associate Professor Ward, *Director of Undergraduate Studies*; Professors Bailey, Bookhout, Costlow, Gillham, Gregg, Klopfer, Livingstone, Nicklas, Schmidt-Nielsen, Tucker, and K. Wilbur; Associate Professors



Barber, Lundberg, Sutherland, Vogel, and Wainwright; Adjunct Associate Professor Schmidt-Koenig; Assistant Professors Colacino, Forward, McClay, Storey, and H. Wilbur; Instructors Delson and Wheeler

See *Biology* for listing of introductory courses.

The L suffix on a zoology course number indicates that the course includes a laboratory.

In addition to those courses bearing the S suffix, the following zoology courses also fulfill the seminar-type learning experience: 103L, 120L, 173L, 180L, 204L, 216L, 218L, 224L, 238L, 258L, 262L.

**95S, 96S. Undergraduate Seminars.** One course maximum except with consent of Director of Undergraduate Studies. *Staff*

**103L. Principles of Ecology.** Physical, chemical, and biological processes that determine the distribution and abundance of animals, emphasizing population dynamics, species interaction, biogeography, nutrient cycling, and energy flow through food webs. Prerequisites: introductory biology and Mathematics 31. Lectures, field and laboratory exercises, and student talks. One course. *H. Wilbur and Livingstone*

**108L. Developmental and Comparative Anatomy of Vertebrates.** Lectures and laboratory on the embryology, anatomy, and evolution of vertebrate organ systems. Not open to students who have had Zoology 53 or 56. Prerequisite: introductory biology. One course. *Lundberg*

**114L. Introduction to Biological Oceanography.** Physical, chemical, and biological processes of the oceans, emphasizing special adaptations for life in the sea and factors controlling distribution and abundance of organisms. Not open to students who have had Geology 53 or Botany 53. Prerequisite: introductory biology. (Given at Beaufort.) One and one-half courses. *Cox, (Visiting Summer Faculty)*

**117. Genetics and Society.** An introduction to genetics with emphasis on the effects of environment and heredity upon the individual and the population. Students may not receive credit for both Zoology 117 and 180 or Nursing 105. Prerequisite: introductory biology or consent of instructor. One course. *Ward*

**120L. Ornithology.** Lectures, laboratory, and field trips dealing with the classification, adaptations, and natural history of birds. Prerequisite: introductory biology. Zoology 108 is recommended. One course. *Bailey*

**135. Evolutionary Systematics.** Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assessment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186, and Zoology 286. Lectures. Prerequisite: introductory biology. (Also listed as Botany 135, Botany 235, and Zoology 235.) One course. *Bailey, Lundberg, and Stone (Botany)*

**135L. Evolutionary Systematics.** See Zoology 135. Lectures and laboratories. One course. *Bailey, Lundberg, and Stone (Botany)*

**150L. Physiology of Marine Animals.** Comparative physiology including ecological and behavioral adaptations. Students may not receive credit for both Zoology 150L and 250L. Prerequisites: introductory biology and Chemistry 12. (Given at Beaufort.) One course. *Forward*

**151L. Principles of Physiology.** An introductory survey. Prerequisites: introductory biology and Chemistry 12. One course. *Tucker*



**160. Principles of Cell Biology.** Structure and function of organelles, metabolism, and regulatory mechanisms. Lectures. Prerequisites: introductory biology and Chemistry 12. One course. *McClay*

**160L. Principles of Cell Biology.** See Zoology 160. Lectures and laboratories. One course. *McClay*

**169L. The Marine Environment.** (For description, see Marine Sciences.) One course. *Sutherland*

**173L. Tutorial in Animal Diversity.** Comparative functional morphology of animals of major phyla. Lectures, laboratories, and tutorials (essays and oral reports). Not open to students who have had Zoology 174, 175, or 275. Prerequisite: introductory biology and consent of instructor. One course. *Wainwright*

**174. Animal Diversity.** See Zoology 173L. Not open to students who have had Zoology 173, 175, or 275. Lectures and laboratories. One course. *Wainwright*

**175L. Invertebrate Zoology.** Free-living and parasitic invertebrates. Lectures, readings, and laboratories; field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174, or 274. Prerequisite: introductory biology. (Also listed as Zoology 275.) One course. *Staff*

**180. Principles of Genetics.** Structure and properties of genes and chromosomes and evolution of genetic systems. Lectures. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or their equivalents. (Also listed as Botany 180, Botany 280, Zoology 280, and under the University Program in Genetics.) One course. *Antonovics (Botany), Boynton (Botany), and Gillham*

**180L. Principles of Genetics.** See Zoology 180. Lectures and laboratories. One course. *Antonovics (Botany), Boynton (Botany), Gillham, and Ward*

**186. Evolutionary Mechanisms.** Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135, Botany 235, Zoology 135, and Zoology 235. Prerequisite: introductory biology. (Also listed as Botany 186, Botany 286, Zoology 286, and under the University Program in Genetics.) One course. *Antonovics (Botany), and H. Wilbur*

**191, 192. Independent Study.** For junior and senior majors with consent of Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*

**193T, 194T. Tutorial.** For senior and junior majors with consent of Director of Undergraduate Studies and the supervising instructor. Three courses of 191, 192, 193T, and 194T maximum. Credit to be arranged. *Staff*

**197, 198. Undergraduate Colloquium.** Does not satisfy major or distributional requirements. One course maximum except with consent of Director of Undergraduate Studies. *Staff*

**199S. Honors Seminar.** For students working toward graduation with distinction in zoology. Prerequisite: consent of Director of Undergraduate Studies. Half course. *Wainwright*

## For Seniors and Graduates

The L suffix on a Zoology course number indicates that the course includes a laboratory.

**201L. Animal Behavior.** Emphasis on recent physiological and develop-

mental studies. Prerequisites: physiology, genetics, and evolution, or consent of instructor. One course. (4 graduate units.) *Klopper*

**202L. Introduction to Comparative Behavior.** Behavior as revealed by physiological, evolutionary, and ecological studies with primary emphasis on marine groups. Prerequisite: one course in physiology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Salamon (Visiting Summer Faculty)*

**203L. Marine Ecology.** Application of ecological theory to marine systems. Mathematical properties of population growth and species interactions; field and laboratory projects with computer-assisted analysis of data. Practice in scientific writing. Readings from current scientific publications. Prerequisites: introductory biology or invertebrate zoology and calculus. Knowledge of statistics helpful. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Sutherland*

**204L. Population and Community Ecology.** Theoretical ecology emphasizing the evolution of life cycles, mathematical properties of systems of interacting species, and mechanisms of species interactions. Laboratories emphasize biometrical and experimental testing of ecological theory in relation to a variety of habitats. Individual projects and weekend field trips. Prerequisites: Zoology 103, calculus, senior or graduate standing, or consent of instructor. One course. (4 graduate units.) *H. Wilbur*

**205. Elements of Theoretical Biology.** An introduction to elementary mathematical biology, conceived as the study of axiomatized mathematical theories and their biological models. Prerequisites: introductory biology and mathematics, or consent of instructor. One course. (3 graduate units.) *Gregg*

**214L. Biological Oceanography.** Adaptations of organisms for life in the sea, the impact of biological processes on the nonliving components of the marine environment, the cycling of energy and matter through marine ecosystems, and the role of physical and chemical processes in marine ecology. Shipboard investigations of biological productivity of the continental shelf ecosystem. Prerequisite: consent of instructor. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barber*

**216L. Limnology.** Lakes, ponds, and streams; their origin, development, geochemistry, energy balance, productivity, and the dynamics of plant and animal communities. Lectures, field trips, and laboratories. Offered in alternate years. Prerequisites: introductory biology, Chemistry 12, physics, and Mathematics 31, or consent of instructor. One course. (4 graduate units.) *Livingstone*

**218L. Paleobiology.** The dynamics of past ecosystems; climatology and ecological geography of the past few million years; laboratory study of lake-bed deposits with emphasis on Quaternary pollen grains. Prerequisites: consent of instructor and a course in ecology. One course. (4 graduate units.) *Livingstone*

**224L. Vertebrate Natural History.** Life histories, adaptations, ecology and classification of vertebrate animals. Prerequisite: Zoology 108. One course. (4 graduate units.) *Bailey*

**229. Morphogenetic Systems.** Lectures on the interplay of theory and experiment in twentieth century developmental biology. Prerequisite: introductory biology. One course. (3 graduate units.) *Gregg*

**235. Evolutionary Systematics.** Evolutionary mechanisms in speciation and phylogeny in plants and animals: geographic and reproductive isolation, breeding systems, hybridization, homology, convergence, and extinction. Assess-

ment of modern techniques (cytotaxonomy, chemotaxonomy, numerical taxonomy) in classification. Complements Botany 186, Botany 286, Zoology 186, Zoology 286. Lectures. Prerequisite: introductory biology. (Also listed as Botany 135, Botany 235, and Zoology 135.) One course. (3 graduate units.) *Bailey, Lundberg, or Stone (Botany)*

**235L. Evolutionary Systematics.** See Zoology 235. Lectures and laboratories. One course. (4 graduate units.) *Bailey, Lundberg, or Stone (Botany)*

**238L. Systematic Zoology.** Theory and practice of collection, identification, and classification of animals. Prerequisite: introductory biology. One course. (4 graduate units.) *Bailey*

**239S. Biogeography.** Old and new distributional concepts of animals and plants involving physical geography, geology, paleontology, systematics, evolution, population dynamics, and dispersal. Prerequisite: consent of instructor. One course. (3 graduate units.) *Bailey*

**245. Radiation Biology.** Actions of ionizing and excitational radiations on life processes; biological use of radioactive tracers; nucleonics. Prerequisites: physics, Mathematics 32, and Chemistry 12. One course. (3 graduate units.) *Fluke*

**246. Physical Biology.** Biomechanics, physical optics and other physical topics applied to living organisms and systems at various levels of organization. Prerequisites: Mathematics 32, Chemistry 12, physics, and one biology course beyond the introductory level, or consent of instructor. One course. (3 graduate units.) *Fluke and Wainwright*

**250L. Physiological Ecology of Marine Animals.** The physiology of marine animals as related to environmental factors of salinity, temperature, oxygen, and light. Prerequisite: a course in physiology. (Given at Beaufort.) One and one half course. (6 graduate units.) *Forward*

**252. Comparative Physiology.** The physiological mechanisms of animals studied on a comparative basis. Prerequisite: Zoology 151 or equivalent. One course. (4 graduate units.) *Schmidt-Nielsen*

**254S. Fluid Flow and Living Systems.** Physical principles of low speed flow; applications to locomotion, circulation, dispersal, ventilation, filtration, and heat dissipation. Prerequisites: physics and Mathematics 31, or their equivalents. One course. (3 graduate units.) *Vogel*

**258L. Laboratory Research Methods.** Radioisotope methods, spectrophotometry, light microscopy, transmission and scanning electron microscopy, X-ray diffraction, gel electrophoresis, isolation of cell components, and other methods. Students may select methods according to their interests and research needs. Prerequisite: consent of instructor. Credits to be arranged. 1-4 units. *K. Wilbur and Staff*

**260. Advanced Cell Biology.** Structural and functional organization of cells and their components, emphasizing current research problems and prospects. Prerequisites: introductory cell biology (or genetics and consent of instructor) introductory biochemistry recommended (may be taken concurrently). One course. (3 graduate units.) *Nicklas, K. Wilbur, and Staff*

**262L. Cytological Materials and Methods.** Cytological analysis, with emphasis on chromosome studies using advanced optical, cytochemical, and experimental techniques. Offered in alternate years. Prerequisite: Zoology 260 or equivalent (may be taken concurrently). One course. (3 graduate units.) *Nicklas*



**265S, 266S. Seminar in Chromosome Biology.** Current research in chromosome structure and function, mitosis, and meiosis. Prerequisites: a course in cell biology or genetics and consent of instructor. (Also listed as Anatomy 265, 266.) Two half courses. (2 units per semester.) *Moses (Anatomy) and Nicklas*

**274L. Marine Invertebrate Zoology.** Structures, functions, and habits of invertebrate animals under natural and experimental conditions. Field trips included. Not open to students who have had Zoology 275. Prerequisite: introductory biology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Barnes (Visiting Summer Faculty)*

**275L. Invertebrate Zoology.** Free-living and parasitic invertebrates. Lectures, readings, and laboratories; field trips to freshwater and marine habitats. Not open to students who have had Zoology 173, 174, or 274. Prerequisite: introductory biology. (Also listed as Zoology 175.) One course. (4 graduate units.) *Staff*

**277L. Endocrinology of Marine Animals.** Control of growth, regeneration, reproduction, metabolism, and other aspects of physiology of marine animals, primarily invertebrates. Offered in alternate years. Prerequisite: one course in physiology. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Staff*

**278L. Invertebrate Embryology.** Lectures, readings, and laboratory work dealing with rearing, development, and life histories of invertebrates. Prerequisites: consent of instructor. (Given at Beaufort.) One and one half courses. (6 graduate units.) *Bookhout*

**280. Principles of Genetics.** Structure and properties of genes and chromosomes and evolution of genetic systems. Prerequisites: introductory biology, Chemistry 12, and Mathematics 31, or their equivalents. (Also listed as Botany 180, Botany 280, Zoology 180, and under the University Program in Genetics.) One course. (3 graduate units.) *Antonovics (Botany), Boynton (Botany), and Gillham*

**286. Evolutionary Mechanism.** Evolutionary mechanisms in population ecology and population genetics of plants and animals: natural selection, adaptation, species interactions, mating systems, fitness concepts, and genetic divergence. Complements Botany 135, Botany 235, Zoology 135, Zoology 235. Prerequisite: introductory biology. (Also listed as Botany 186, Botany 286, Zoology 186, and under the University Program in Genetics.) One course. (3 graduate units.) *Antonovics (Botany) and H. Wilbur*

**288S. The Cell in Development and Heredity.** A seminar on topics of current interest and controversy. Prerequisites: a course in genetics and consent of instructor. (Also listed as Anatomy 288.) Half course. (2 graduate units.) *Counce (Anatomy)*

**295S, 296S. Seminar.** Topics, instructors, and course credits announced each semester. *Staff*

**Genetics, The University Program.** Genetics courses offered by the Department of Zoology are part of The University Program in Genetics described in this *Bulletin*.

**Marine Laboratory.** Consult Marine Sciences in this *Bulletin* for offerings at the Duke University Marine Laboratory and for details of the spring semester program for undergraduates at Beaufort.



## DEPARTMENTAL MAJOR

*Prerequisites.* Biology 11-12 or Biology 14 or consent of Director of Undergraduate Studies.

*Major Requirements.* A minimum of eight courses, not including the above prerequisites. They must include no fewer than five zoology courses; of which at least four must be other than independent study, tutorials, or seminars, and of which at least two must have related laboratory experience. They may include at most three non-zoology courses taken in at least two appropriate related departments, provided that they are at the 100-level or above (in chemistry, above organic chemistry) and that they have received the prior approval of the Director of Undergraduate Studies. No one course may be used to satisfy the requirements for zoology and another major, or for a zoology major and a second or third division distributional requirement.

*Areas of Concentration.* Molecular and cellular biology (cell physiology, cytology, genetics, development); organismic biology (comparative physiology, comparative and functional morphology, embryology); population biology (population genetics, speciation, systematics, biogeography); animal behavior; ecology (including biological oceanography and limnology).

*Departmental Handbook for Majors.* Any student who is interested should obtain a copy of the *Handbook for Zoology Majors* from the office of the Director of Undergraduate Studies. The handbook suggests appropriate combinations of courses for the above listed areas of study, describes the advising system and special programs, and gives the interests and background of the faculty.

*A.B. and B.S. Degrees.* No distinction is made between the A.B. and B.S. degree; a student may elect to receive either degree.

**Interdepartmental Concentration.** An interdepartmental program (e.g., in cell and molecular biology, physical biology, marine biology, etc.) may be pursued instead of a departmental major. The director of undergraduate studies in botany or zoology will arrange administrative responsibility for such programs.

## School of Nursing

Professor Wilson, *Dean*; Associate Professor Most, *Director of Academic Programs*; Professors Fortune, Gratz, Minniear, and Stone; Associate Professors Hall, Hogue, Horton, Norville, and Schenk; Assistant Professors Anderson, Askins, Bourbous, Brundage, Bullock, Craig, Davenport, Dery, Dietz, Gelein, Graedon, Hewitt, Humphrey, Kaufman, Kirkpatrick, Lavacca, Long, Lynds, McCool, Persing, Smith, Turner, White, and Woods; Instructors Lichy, Messick, Morgan, Mullinix, Schafer, Stefanics, and Yoder; Lecturers Harris, Mandetta, Mendell, Reckless, and Tolley; Clinical Faculty Barton, Brown, Burkett, Hill, Honea, O'Toole, and Rosser

**97, 98. Human Ecology I and II.** An interdisciplinary course in the natural sciences covering the impact of a changing physical and biological environment upon man. Open to non-nursing majors. Two courses. *Gratz*

**99. Introduction to Statistics in the Health Field.** Statistical concepts involved in the compilation, presentation, and analysis of health data. Measures and methods to describe, correlate, and make inferences about frequency distributions. Open to non-nursing majors. Priority will be given to sophomore nursing students. One course. *Staff*

**101-102. Theoretic and Scientific Bases of Nursing Practices.** Builds upon courses in human ecology to explore major theories of man's normal adaptive responses throughout the life cycle. Concepts relating to the nurse-patient

relationship, man's self system and man in the context of his other super-systems of family, community, and society are explored. A systems theory framework is used to consider major assaults to man's integrity and responses to threats to health. Prerequisites: Nursing 97 and 98 or equivalent. Nursing 101 is a prerequisite to 102. Two courses. *Staff*

**103-104. Development of Nursing Skills and Attitudes.** Correlated with Nursing 101-102 by selection of clients of a variety of ages as exemplars of man's normal adaptation and his response to assaults. Students will be giving nursing care to individuals in a variety of settings. Application of theory and concepts from Nursing 101 and 102 are facilitated in a weekly seminar of clinical groups. Nursing practice encompasses the development of psychomotor skills, cognitive skills, and attitudes essential to the process of nursing. Prerequisites: Nursing 97 and 98 or equivalent. Nursing 101 and 103 are prerequisite to 104. Four courses. *Staff*

**105. Human Genetics and Societal Problems.** A course in the current state of research on birth defects, biochemical disorders, the human chromosome complement, and malformations resulting from mishaps in the chromosomes. Open to non-nursing majors. Pass/fail option. Fall only. Not offered 1976-77. One course. *Gratz*

**121S. Parenthood.** An investigation of parenting behavior with a focus on the meaning of experiences to the mother and father and the means by which individuals can maximize the positive potential of these experiences. Open to sophomores or above and non-nursing majors. Pass/fail option. One course. *Harris*

**125. Theory and Practice of Communication.** Students interview selected individuals for the purpose of practicing effective communication skills and methods of interviewing. When possible, the student develops an ongoing short term relationship to facilitate the individual's problem-solving process. Group conferences are utilized for faculty and peer supervision to maximize student learning to evaluate effectiveness of interactions. Classes utilize lectures, audio-visual demonstrations, gaming, and simulation, and student-led discussions. Prerequisite: consent of instructor. Pass/fail option. One course. *Bourbous and Craig*

**144. An Introduction to Gerontology.** A student of the process of aging as it relates to the elderly with focus on physiological, sociopsychological changes, and economic status. Emphasis will be on selected areas such as theories of aging, demographic changes and social policy. Open to sophomore through senior students including non-nursing majors. Pass/fail option. Spring only. One course. *Stone*

**146. Cross-Cultural Perspectives on Health Care Delivery.** Health care in several socio-cultural environments is explored, with emphasis on health delivery in developing regions. Theoretical bases for assessing and evaluating existing health programs and for predicting outcomes of planned change are examined, and individual and agency motivations for exporting health care programs are compared. Techniques for maintaining physical and mental health in the field are presented. Open to sophomores and above with consent of instructor. Pass/fail option. (Also listed as Anthropology 146.) One course. *Dietz and Graedon*

**151. Functional Aspects of Nursing Practice.** Theories, practices, and constraints influencing functional roles in nursing practice, e.g., economics and systems of health care, organization, and administration of agencies and insti-

tutions delivering health care, legal protection, and constraints of the practitioner. Prerequisites: Nursing 102 and 104. One course. *Dietz*

**153, 154. Distributive and Episodic Nursing Practice.** Continuation of Nursing 101-102, and Nursing 103-104 into the senior year. Each student will have learning experiences with patients in each of the major clinical areas: medical-surgical, psychiatric, maternal and child health, and community health nursing. In distributive nursing practice, a systems perspective is the approach for acquiring the conceptual, interpersonal, and technical skills for the promotion, maintenance, and restoration of health and prevention of illness for designated populations. The concept of distributive nursing practices has been broadly conceived to encompass the study of multiple components of care. Some of these components may be defined in the context of community nursing practice but they also encompass both primary care and long-term care in community facilities and other types of ambulatory health service settings. The focus of episodic nursing practice is the direct care of hospitalized patients with complex, acute or chronic, mental, and physical illness wherein rapid and/or crucial nursing decisions are required and collaboration with other health disciplines is essential. Prerequisites: Nursing 102 and 104. Four courses. *Staff*

**161. Applied Human Physiology.** An in-depth study of selected physiological processes significant to the health needs of man. Emphasis is upon those aspects of physiology that are reflected in patient care problems requiring effective nursing intervention. Prerequisite: Nursing 98 or equivalent. Pass/fail option. Fall only. One course. *Gratz*

**162. Ecological Concepts and Their Applications to Environmental Health.** An in-depth study of current environmental problems significant to the health needs of man. Emphasis is on those ecological concepts that are reflected in patient health problems. Open to non-nursing majors. Pass/fail option. Spring only. One course. *Gratz*

**167S. Poverty and Health.** A study of poverty designed to develop an awareness of the relationship between poverty and health. Seminars, films, and actual experience with poverty groups will be used to acquaint the student with a diversity of perceptions and observations germane to an understanding of health problems among the poor. Open to sophomores and above including non-nursing majors with consent of instructor. Pass/fail option. One course. *Humphrey and Long*

**169. Human Sexuality.** A study of the intrapersonal, interpersonal, and sexual aspects of an individual's existence and the forces shaping prevailing and future sexual expressions and human sexuality. Open to non-nursing majors. Pass/fail option. One course. *Mandetta, Reckless, and Woods*

**172. Psychosomatic Illness and Group Process.** A study of patients with psychosomatic and somatopsychic illness with opportunities to explore causal factors together with approaches for alleviation. Students assume responsibility for direct patient care under supervision and have the opportunity to attend group therapy sessions. Prerequisite: consent of instructor. Pass/fail option. One course. *Reckless*

**178S. Advanced Concepts of Nursing for Patients with Cardiovascular Disease.** Examination and clinical exploration of the role of the nurse in providing health care to individuals with cardiovascular disease. Open to senior nursing students. Pass/fail option. One course. *Gelein and Kirkpatrick*

**179. Nursing in Nephrology.** Planned experience providing nursing care for patients with clinical disturbances of renal function utilizing current treatment



modalities in a variety of treatment settings. Open to second semester juniors and seniors in the nursing major. Pass/fail option. One course. *Brundage*

**183. Introduction to Methods of Research in Nursing.** Study of research in nursing and the implications for nursing practice. Prerequisites: basic statistics and Nursing 103 or consent of the instructor. Pass/fail option. One course. *Most*

**191, 192, 193, or 194. Independent Study.** Demonstration of self-direction in planning, implementing, evaluating, and reporting an independent learning experience. The required study for nursing majors must focus on nursing. Minimum of one course. Pass/fail option. *Staff*

**197, 198. Undergraduate Thesis.** Systematic study of a nursing problem. The study culminates in a written thesis. The method of study may involve research or may be limited to the student's critical review of others' work which bears upon the problem selected for study. Prerequisites: completion of the junior year with at least a B+ average in all nursing courses, including electives in nursing, and consent of course coordinator. Two courses. *Hogue*

**205. Patient Assessment.** A study of health status through methods and techniques of eliciting health history and physical examination. Common but major clinical problems receive focus through discussion and observation. Open to senior and graduate nursing students with consent of instructor. Pass/fail option. One course. *Wilson*

**225. Work and Health.** Relationships between work and health are explored within a systems framework in which work in its organized form is viewed as stressful yet a significant offering of modern society for preventing even greater stress. Constraints and opportunities in work are considered through exploration of career, task, and organization stresses. Individual, family, and organizational strategies and tactics for dealing with the complex network of factors associated with work are presented. Open to senior and graduate students. Pass/fail option. One course. *Hogue*

**263. Crisis Intervention and Suicidology.** Exploration of crisis theories with methods of intervention in assisting individuals and families, before, during, and following the crisis. Discussions of specific human and environmental crises with emphasis on suicidal behavior. Application of theories and techniques through clinical practice. Open to senior and graduate nursing students with consent of instructor. Pass/fail option. One course. *Hewitt and Stefanics*

**269. Clinical Aspects of Human Sexuality.** Clinical Aspects of Human Sexuality is a course designed to explore the nurse's role in education and counseling for a healthy sexuality. The course focuses on prevention of sexual problems by means of the educative process, anticipatory guidance, and counseling. Sexual dysfunction associated with life events, medical or surgical therapy, trauma, and hospitalization will be considered. In addition, adaptation to the sequellae of sexual relationships such as pregnancy, venereal disease, and abortion will be explored in the clinical setting. Prerequisite: 169 or consent of instructor. Pass/fail option. One course. *Woods*

**186. Thanatology.** An indepth exploration of man's relationship to death. The course emphasizes feelings about death and examines and integrates clinical and theoretical materials from the social sciences and helping professions. Open to senior and graduate nursing students with consent of instructor. Pass/fail option. One course. *Gelein*

**288. Oncological Nursing.** An indepth study of nursing the patient with cancer, focusing on prevention, detection, diagnosis, treatment and rehabilita-



tion. Classes will be shared with the medical students enrolled in surgery 291C and/or 201C. These classes will be taught by the Interdisciplinary Oncology Faculty from the Comprehensive Cancer Center. Open to senior and graduate nursing students. Pass/fail option. One course. *Norville*

## MAJOR IN NURSING

The major requirements are included in the minimum total of thirty-two courses listed under lower and upper division requirements on page 00. The specific courses in the upper division satisfying the nursing major that must be included are: Nursing 101, 102, 103, 104, 151, 153, 154, and 191, 192, 193, or 194.

## School of Engineering

### ENGINEERING (INTERDEPARTMENTAL)

**5, 6. Engineering Experience.** In order to provide opportunities for engineering freshmen to become involved in engineering activity and to assist them in determining areas of interest, a number of engineering faculty members have developed miniprojects approved by the department of the faculty member. Consent of instructor is required. Pass/fail. Two quarter courses. *Staff*

**11. Engineering Graphics.** Graphical theory and techniques for engineering design and communication. Visualization and conventional representation of points, lines, surfaces, and objects using freehand sketches. Orthographic (including sectional and auxiliary), perspective, isometric, and oblique views. Introduction to working drawings. Elements of descriptive geometry, and graphic mathematics. Not open to seniors. Half course. *Arges*

**51. Computers in Engineering.** Introduction to use of digital computers in engineering. Attributes of digital computer systems; program languages, flow charts; numerical analysis, including approximation and interpolation, searches and maximization, linear equations; applications to engineering; introduction to decision processes in engineering, including linear programming, optimization network methods; punched card operation; graphical output. Not open to students who have completed Computer Science 51. One course. *Garg, Tsui, and Utku*

**72. Introduction to Systems Dynamics.** Unified treatment of mechanical, electrical, fluid, and thermal dynamic systems. Formulation and solution of differential equations; operators, transfer functions, and complex variables. Energy concepts for multiport system analysis. Simulation and analog solution of a variety of engineering problems. Prerequisites: Physics 51 and Mathematics 32. One course. *Garg, Macduff, or Wright*

**75. Mechanics of Solids.** Analysis of force systems and their equilibria as applied to engineering systems. Stresses and strains in deformable bodies; mechanical behavior of materials; applications of principles to static problems of beams, torsion members, and columns. Selected laboratory work. Prerequisites: Physics 51 and Mathematics 32. One course. *Arges, Palmer, and J. F. Wilson*

**83. Structure and Properties of Solids.** An introduction to materials science and engineering, emphasizing the relationships between the structure of a solid and its properties. The atomic and molecular origins of electrical, mechanical, and chemical behavior are treated in some detail for metals, alloys, polymers, ceramics, glasses, and composite materials. Prerequisites: Chemistry 11 and Mathematics 31. One course. *Cocks, Pearsall, and Shepard*

**101. Thermodynamics.** A rigorous development of engineering thermodynamics emphasizing the logical structure and manipulation. Classical and statistical concepts of the laws of thermodynamics. Energy and entropy analyses of thermodynamic systems. Property relationships. Chemically reactive systems. Application to power production and energy conversion. Prerequisites: Physics 51 and Mathematics 103. One course. *Elsevier or Harman*

**104. Thermodynamics and Heat Transfer.** Development of the laws of thermodynamics emphasizing the logical structure and manipulation. Thermodynamic property relations for simple substances and mixtures. Solutions of energy problems which concentrate on methods of analysis. Introduction to conduction, convection, and radiation modes of heat transfer. Prerequisites: Physics 52 and Mathematics 103. One course. *Chaddock or Elsevier*

**113. Current Topics in Materials Science.** Extension of the principles of Engineering 83 to areas of current interest, including biomaterials, fuel cells, composite materials, materials problems in energy conversion systems, computer systems, stress corrosion cracking, and other topics. Prerequisite: Engineering 83. One course. *Cocks, Pearsall, and Shepard*

**122. Transport Phenomena.** A unified treatment of momentum, energy, and mass transport from the continuum viewpoint. Parallel developments of the basic relationships, design equations, and engineering applications illustrate problem solving and the usefulness of analogy between the three transport mechanisms. Selected laboratory work. Prerequisites: Physics 52 and Mathematics 103. One course. *Chaddock or Harman*

**123. Dynamics.** An introduction to the principles of particle and rigid body dynamics with engineering applications. Vector analysis used to describe the kinematics of motion in space and in a plane; the inertia tensor. Concepts of impulse-momentum and work-energy. An introduction to vibrations, wave motion, and Lagrange's equation. Prerequisites: Mathematics 103 and Physics 51. One course. *Dvorak and J. F. Wilson*

**135. Continuum Mechanics.** The concept of continua. Vectors. Cartesian Tensors. Equilibrium; stress, deformation, and velocity fields; compatibility. Isotropy. Constitutive equations. Virtual work principle. Mechanical properties of solids and fluids. Simple problems in elasticity, viscoelasticity, and plasticity. Prerequisites: Physics 51, Mathematics 104 or 111. One course. *Dvorak*

**145. Fluid Mechanics.** Physical properties of fluids; fluid-flow concepts and basic equations; continuity, energy and momentum principles; dimensional analysis and dynamic similitude; viscous effects; applications emphasizing real fluids. Selected laboratory work. Corequisite: Engineering 123 or Mechanical Engineering 123. One course. *Muga and J. F. Wilson*

**161, 162. Interdisciplinary Resources for Community Problem-Solving.** The objectives of this course are to assist the student in an understanding of the self, the interaction of the self with others and the environment, and in the analysis of information useful for decision-making. Problems in the community are used as a vehicle for developing group and individual approaches to the resolution of specific problems of interest to the students in the course. Prerequisite: consent of the instructor. Two courses. *Artley*

**174. Technology Assessment and Social Choice.** Engineering, economic, environmental, socio-psychological, and ethical considerations in the design and application of technological systems; technological forecasting; assessment methodology; impact evaluation; case studies; citizen participation and feedback. (Also listed as Public Policy Studies 174.) One course. *Garg and Clark*

**175. Aesthetics, Design, and Culture.** An examination of the role of aesthetics, both as a goal, and as a tool, in a culture which is increasingly dependent on technology. Visual thinking, perceptual awareness, experimental learning, conceptual modeling, and design will be explored in terms of changes in one's sensory environment. Line, space, texture, color, and value will be experienced and analyzed through individual and group problem-solving and problem-formulating design projects. Fall semester. One course. *Pearsall*

**183, 184. Projects in Engineering.** Courses in which engineering projects of an interdisciplinary nature are undertaken. The projects must have engineering relevance in the sense of undertaking to meet human need through a disciplined approach under the guidance of a member of the engineering faculty. Prerequisite: consent of the instructor. Two courses. *Engineering Faculty*

## BIOMEDICAL ENGINEERING

Professor Pilkington, *Chairman*; Professor Clark, *Director of Undergraduate Studies*; Professors McElhaney, Nolte, Thurstone, and Wolbarsht; Associate Professors Barr, Evans, Hammond, and Wachtel; Assistant Professors Tolley and von Ramm

Biomedical engineering includes the application of concepts and methods in the physical, mathematical, and engineering sciences to biology and medicine. This definition covers a broad spectrum ranging from formalized mathematical theory through experimental science to practical clinical applications. The purpose of the undergraduate program in biomedical engineering is to permit students to prepare themselves for graduate work in biomedical engineering, medicine, or biology. This program is flexible and can satisfy the requirements for entrance to graduate work in engineering, physiology, biology, or to medical school.

Opportunities for student research are available in the following biomedical engineering laboratories: The Cardio-Respiratory Systems Laboratory includes a PDP-12 digital computer, a PAR signal averager, and an analog computer. Computer science techniques are utilized in acquiring, processing, and modeling biological data. Research in the Biomedical Materials Laboratory is directed toward the development of materials suitable for use in biological environments such as the vascular system. Biomedical Engineering in Pediatric Cardiology measures electrical activity of the heart in animals and humans, to increase the basic knowledge of the heart itself. The Optics and Acoustics Laboratories are employed for research and instruction in the biomedical application of these fundamental areas. Ultrasound instrumentation measures and images biological tissue structures. The Electrobiolgy Laboratory explores the communication of information between individual nerve cells in prototypical brains. Optical, mechanical, and electronic equipment is used in recording neural activity, and computational equipment is employed for data analysis and simulation.

**111. Introduction to Biomedical Physics.** Engineering and physical science approach to human physiology. Specific topics include: (1) cell environment interaction (metabolism, membrane physical chemistry, dynamics, and information transmission); (2) oxygen transport system (cardiovascular, respiratory, and blood); (3) water/balance (renal system); (4) control/integration (endocrine and neural). One course. *Wachtel*

**125. Mechanics of Biological Materials.** An introduction to mechanics of solid, semi-solid, and liquid material elements of biological tissues. The relationship of continuum properties to molecular arrangements will be made



through statistical thermodynamics. Prerequisite: Engineering 135 or equivalent. One course. *Evans*

**131,132. Statistical and Computational Methods in Data Analysis.** Difference equations and simulations, matrix calculus, probability, least squares, filtering, smoothing, hypothesis testing, and minimization procedures. Corequisite: Mathematics 104 or Mathematics 111. Two courses. *Tolley*

**163, 164. Biomedical Electronics and Measurements.** A study of the basic principles of biomedical electronics and measurements with emphasis on the operational performance and selection of transducers, instruments, and systems for biomedical data acquisition and processing. Selected laboratory work emphasizes the measurements of specific physiological events. Prerequisite: Electrical Engineering 63 or Engineering 72. Two courses. *Hammond, Thurstone, or von Ramm*

**172. Biomedical Transfer Processes.** An introduction to transfer processes and life systems with emphasis on biological interactions of artificial materials and environmental studies. Prerequisite: Mechanical Engineering 126. One course. *Clark*

**187. Introductory Biomechanics.** Static and dynamic analysis of biological systems, analysis of gait and locomotion, function and form, mechanical properties of tissues, human tolerance to impact and vibration, design of restraint systems, ejection seats and helmets. Selected experiments to demonstrate mechanical principles in biology. Prerequisite Engineering 135. One course. *McElhane*

**191, 192. Projects in Biomedical Engineering.** This course is available to seniors who express a desire for such work and who have shown aptitude for research in one area of biomedical engineering. Half course to two courses. *Staff*

**201. Analysis of Bioelectric Phenomena.** Fundamentals of bioelectric modeling with particular emphasis on neural and cardiovascular systems exhibiting phenomena varying from cellular to the whole organism level. One course. (3 graduate units.) *Wachtel*

**202. Energy and Rate in Biological Processes.** An introduction to biomedical thermodynamics and transfer processes with particular emphasis on environmental studies, hyperbaric exposure, and the functions of natural and artificial organs. Not open to students who have had Biomedical Engineering 172. One course. (3 graduate units.) *Clark*

**203. Bioelectric Potentials and Field Theory.** A study of bioelectric potentials and models for their generation. Analysis from a field theoretic point of view with particular emphasis on formulations that are amenable to computation. One course. (3 graduate units.) *Pilkington*

**204. Real Time Measurement and Control of Heart Events.** Specification of procedures and devices from biological considerations, and their design and construction. Consideration of amplifiers, analog-digital conversion, computer interfaces, and associated programming. Evaluation of selected examples for accuracy, complexity, and cost. One course. (3 graduate units.) *Barr*

**207. Experimental Mechanics.** Experimental studies and techniques basic to mechanics, stress-strain measurements and transducers, dynamic force, acceleration and flow measurements and analysis, viscoelastic behavior and modeling, high speed photographic methods, general applications to biomechanics including gait and analysis, head injury, automotive safety criteria, and blood flow. One course. (3 graduate units.) *McElhane*



**223. Biomedical Materials and Artificial Organs.** The use of artificial organs to replace or augment natural function in pumping and oxygenation of blood, removal of nitrogenous wastes and other toxins, and prostheses which have mechanical, chemical, or cosmetic function. Emphasis is placed on molecular architecture of materials for use in biological environment and optimization of parameters of materials which determine their utility in varying applications. One course. (3 graduate units.) *Clark*

**225. Mechanics of Cellular Components.** Concepts of solid, semi-solid, and liquid mechanics applied to the study of cell components, e.g., membranes, cytoplasm, organelles, nuclei, etc. Transition from molecular structure to continuum properties will be emphasized. Prerequisite: consent of instructor. One course. (3 graduate units.) *Evans*

**230. Biomechanics.** Kinematic models of human motions, mechanical properties of bone and soft tissues, hydrodynamics of micturition, load directed growth mechanisms, human tolerance to impact and vibration, head injury criteria applied to helmet design. Prerequisite: consent of instructor. One course. (3 graduate units.) *McElhaney*

**233. Discrete Systems and Models of Computation.** Difference equations, numerical approximation, and digital filters with particular emphasis on developing constrained models that are both physically reasonable and amenable to computation. One course. (3 graduate units.) *Pilkington*

**241, 242. Information Organization and Retrieval.** (Also listed as Computer Science 241, 242.) Two courses. (6 graduate units.) *Hammond*

**243. Computers in Biomedical Engineering.** An in-depth study of the use of computers in biomedical applications. Hardware, software, and applications programming will be considered. Data collection, analysis, and presentation will be studied within application areas such as monitoring, medical records, computer-aided diagnoses, computer-aided instruction, MD-assistance programs, laboratory processing, wave form analysis, hospital information systems, and medical information systems. One course. (3 graduate units.) *Hammond*

**252. Marine Electrobiolgy.** The physiology and behavioral consequences of bioelectric activity ranging from the cell membrane to the interanimal communication level. Laboratory work deals with bioelectric recording and stimulation techniques with particular emphasis placed on electrophysiological studies of marine organisms wherein cellular correlates of animal behavior are clearly seen. Ionic basis of bioelectric signals, transmission of signals within and between cells, relation of bioelectric signals to particular behavioral patterns, effects of externally applied electric fields, bioelectric communication and navigation systems. Prerequisites: consent of instructor. Summer at Beaufort. (Also listed as Physiology and Pharmacology 222.) One and one half courses. (6 graduate units.) *Wachtel and Wolbarsht*

**265. Advanced Topics in Biomedical Engineering.** Advanced subjects related to programs within biomedical engineering tailored to fit the requirements of a small group. Prerequisites: consent of chairman and instructor under whom the work will be done. One course. (1 to 4 graduate units.) *Staff*

### **Departmental Major in Biomedical Engineering**

The major requirements are included in the minimum total of thirty-two courses listed under general requirements and departmental requirements. The specific courses Biomedical Engineering 111, 125, 131, 132, 163, 164, and 172 must be included.

## CIVIL ENGINEERING

Professor Muga, *Chairman*; Professor Brown, *Director of Undergraduate Studies*; Professors Dvorak, Utku, and Vesic; Associate Professors Dajani, Palmer, Vesilind, and J. F. Wilson; Assistant Professors Arges and Tsui; Adjunct Professor Saibel; Adjunct Assistant Professor Warner; Instructors Hayward and Abo-Hamd; Lecturers Lathrop and Rimer

Civil engineering involves the conception, design, analysis, and building of constructed facilities. However, the modern civil engineer may find himself engaged in such complex problems as trafficability of planetary surfaces, environmental planning for a community, or optimization of an urban transportation system. There are seven major speciality areas of civil engineering at Duke. Environmental engineering deals with the quality of human environment as affected by water supply and waste-water treatment and disposal. Geotechnical engineering is concerned with interaction between engineering structures and the earth's crust as well as with structures constructed of earth as a material. Mechanics and materials engineering is the study of the behavior of materials under various conditions of loading and environment. Ocean engineering deals with the development and use of marine resources. Structural engineering is concerned with economical and safe design of engineering structures. Urban engineering encompasses a broad spectrum of integrated technological problems such as land and city planning and development, mass transportation, and public health and safety. Water resources engineering is concerned with the usage, preservation, and replenishment of water resources. In addition, a student may elect a general program of civil engineering studies or an interdisciplinary program of management sciences combined with civil engineering. He may also pursue a degree with a double major in civil engineering and the policy sciences, by additionally satisfying the requirements of the Institute of Policy Sciences.

The civil engineering program at Duke is supported by several laboratories for instruction and research. The Structural Engineering Laboratory has universal testing machines with capacities to 400,000 pounds; hardness testers; and machines for testing torsion, fatigue, and impact. The department has facilities for the construction and testing of structural models, including medium-speed electronic equipment for the measurement and recording of strains and displacements. The Soil Mechanics Laboratory includes modern testing equipment and instruments, such as static and dynamic and model testing accessories, as well as a triaxial shear apparatus, designed for testing soil and rock at confining pressures up to 100,000 pounds per square inch. The Fluid Mechanics Laboratory equipment includes a water wave flume with paddle-type variable frequency, constant amplitude, wave generator, and a variety of sensors. The Sanitary Engineering Laboratory is equipped for determining the characterization of waters and wastewaters and for applying biological, chemical, and physical treatment methods to improve their quality. The Materials Laboratory deals with the physical properties and stress-deformation characteristics of bituminous mixtures and concretes. The Urban Systems Laboratory is equipped with a PDP-8 digital computer and a teletype terminal. The department has a representative collection of modern surveying equipment.

**16. Surveying for Engineers.** The theory and application of measurements required for planning, design, and construction of engineered facilities. Transit-tape and stadia surveys; differential and profile leveling; traverse computations. Laboratory included. Not open to seniors. Corequisite: Mathematics 31. Half course. *Arges*

**116. Transportation Engineering.** The role and history of transportation. Introduction to the planning and design of links, vehicles, and terminals of all

transportation modes. Principles of traffic engineering and route location and design. Planning studies and economic evaluation. Prerequisite: junior or senior standing; consent of instructor for non-engineering students. One course. *Dajani*

**117. Public Systems Planning.** The systems approach to public policy planning. Mathematical modeling and computer simulation techniques. Estimation, forecasting, and decision-making. System evaluation models. Decision processes in the land-use, transportation, public utilities, and urban service sectors. Prerequisite: Mathematics 32. One course. *Dajani*

**123. Water Resources Engineering.** Hydraulics of pressure conduits and measurements of flow, compound pipe systems, analysis of flow in pressure distribution systems, descriptive and quantitative hydrology applied to problems of irrigation and drainage, open channel flow, reservoirs and distribution system storage. Selected laboratory work. Prerequisite: Engineering 145. One course. *Muga*

**124. Environmental Engineering.** Qualitative and quantitative physical, chemical, and bacteriological characterization of water and wastewater. Introduction to water treatment processes and wastewater collection, treatment and disposal systems; elements of environmental sanitation. Laboratory included. Field trips to be arranged. Corequisite: Engineering 145 or consent of the instructor for non-civil engineering students. One course. *Rimer and Vesilind*

**127. Environmental Pollution Control.** A study of the environment—causes and effects of air, land, and water pollution. Interactions between the environment and stresses to which it is subjected as a consequence of growth and concentration of populations and their increasing demands on natural resources. Solid waste, recycling, noise pollution, and environmental ethics. For non-civil engineering students. One course. *Vesilind*

**131. Theory of Structures.** A first course in the application of mechanics to the analysis of plane and space structures; a unified treatment of statically determinate and indeterminate structural systems. Prerequisites: Mathematics 103 and Engineering 75. One course. *Brown*

**133. Structural Design I.** Nonhomogenous materials. Determination of physical and mechanical properties of construction materials. Theory and design of compression and flexural members. Emphasis on ultimate strength theory for concrete. Timber design using mechanical fasteners, selected design problems in concrete to include form and timber supports. Prerequisite: Civil Engineering 131. One course. *Brown*

**134. Structural Design II.** Design in metals, primarily steel. Properties of materials as criteria for failure. Tension, compression, and flexural members. Riveted, bolted, and welded connections, including eccentric connections. Built-up members. Design by elastic and plastic methods. Selected problems to include computations and drawings. Prerequisite: Civil Engineering 131. One course. *Palmer*

**139. Introduction to Soil Mechanics.** Origin and composition of soils, soil structure. Flow of water through soils; capillary and osmotic phenomena. Soil behavior under stress; compressibility, shear strength. Elements of mechanics of soil masses with application to problems of bearing capacity of foundations, earth pressure on retaining walls, and stability of slopes. Laboratory included. Prerequisites: Engineering 83 and 145. One course. *Tsui and Vesic*

**141, 142. Special Topics in Civil Engineering.** Study arranged on a special topic in which the instructor has particular interest and competence as a result



of research and professional activities. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Each half course or one course. *Staff*

**146. Professional Engineering.** A study of general topics related to the professional practice of engineering with emphasis on economic and legal aspects. Monetary basis for engineering decisions, economic alternatives; contracts, specifications, ethics; quantity and cost estimates; scheduling by the Critical Path Method. Presentation of student papers on current or unique engineering topics. Prerequisite: junior or senior standing in engineering. One course. *Palmer*

**173. Ocean Engineering.** An introductory course to acquaint the student with the basics of physical and chemical oceanography and the need for and application of engineering knowledge and methods to the design and operation of structures, vehicles, and communication systems for use on land and in the oceans. Prerequisite: junior standing in any department. (Also listed as Mechanical Engineering 173.) One course. *Linderoth, Muga, and J. F. Wilson*

**197, 198. Projects in Civil Engineering.** These courses may be taken by junior and senior engineering students who have demonstrated aptitude for independent work. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Each half course or one course. *Staff*

**201. Advanced Mechanics of Solids.** Cartesian tensors, dyadics, and matrices. Analysis of states of stress and strain. Conservation laws and field equations. Constitutive equations for elastic, viscoelastic, and elastic-plastic solids. Formulation and solution of simple problems in elasticity, viscoelasticity, and plasticity. Corequisite: Mathematics 285 or equivalent. One course. (3 graduate units.) *Dvorak*

**204. Plates and Shells.** Differential equation and extremum formulations of linear equilibrium problems of Kirchhoffian and non-Kirchhoffian plates of isotropic and orthotropic material. Solution methods. Differential equation formulation of thin shell problems in curvilinear coordinates; membrane and bending theories; specialization for shallow shells, shells of revolution, and plates. Extremum formulation of shell problems. Solution methods. Prerequisites: Mathematics 104, and Engineering 75 or Engineering 135, or consent of instructor. One course. (3 graduate units.) *Utku*

**205. Elasticity.** Introduction to linear theory of elasticity. Constitutive equations for anisotropic and isotropic elastic solids. Formulation and solution of torsion, bending, and plane problems by semi-inverse, complex potential, and variational methods. Three-dimensional problems. Prerequisite: Civil Engineering 201 or equivalent. One course. (3 graduate units.) *Dvorak*

**206. Advanced Mechanics of Solids II.** Continuum theories for time-independent and time-dependent materials. Formulation and solution of boundary value problems; analytical and numerical techniques, applications. Prerequisite: Engineering 135, or Civil Engineering 201. One course. (3 graduate units.) *Dvorak*

**209. Structural Dynamics.** Vibration and stability (small and global) of discrete and continuous linear systems; introduction to nonlinear theory, parametric and random excitation. Applications include response studies of machines, ships, pipelines, bridges and buildings to man-made and nature-induced loadings. (Listed also as Mechanical Engineering 209.) One course. (3 graduate units.) *J. F. Wilson*



**210. Intermediate Dynamics.** (Also listed as Mechanical Engineering 210.) One course. (3 graduate units.) *Macduff or J. F. Wilson*

**212. Mechanical Behavior of Materials.** Mechanical behavior and its relationship to microstructural deformation and fracture processes in polycrystalline, polymeric, and composite materials. Influence of temperature, strain rate, and environmental conditions on material behavior. Fracture mechanics and its application to brittle and ductile fracture, and fatigue in structural metals, polymers, composites, and concrete. Prerequisite: Civil Engineering 201. One course. (3 graduate units.) *Dvorak*

**215. Urban and Regional Geography.** Human settlements and locational patterns. Location theory and land-use systems. Normative and descriptive location decisions. Location and impact of constructed facilities. Spatial interaction and network structure. Geography of transportation and environmental quality. One course. (3 graduate units.) *Dajani*

**216. Transportation Planning and Policy Analysis.** Issues in policy planning and decision-making in urban and rural transportation systems. Transportation legislation. Public transportation alternatives with emphasis on public transit and paratransit solutions. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. (Also listed as Public Policy Science 254.) One course. (3 graduate units.) *Dajani*

**217. Transportation Systems Analysis.** The transportation systems planning process. Quantitative analysis, mathematical modeling and computer simulation techniques for short and long-range planning and evaluation of transportation systems. Prerequisite or corequisite: Civil Engineering 116 or consent of instructor. One course. (3 graduate units.) *Dajani*

**218. Engineering-Economic Analysis.** Methods of analysis applicable to the economic evaluation of both pre-construction project plans and post-construction project outcomes. Principles of engineering economics with regard to time dependent costs and benefits. Techniques of economic evaluation and comparisons of multiple alternatives. Concepts of welfare economics with regard to public works development. Identification and measurements of both monetary and non-monetary consequences of public works. Student projects involving the analysis and evaluation of public investments. One course. (3 graduate units.) *Dajani or Warner*

**221. Incompressible Fluid Flow.** Steady and unsteady pipe flow; theories of turbulent flow; water hammer theory and control; surge tanks; air chambers; the analysis and control of fluid systems; effect of resistance; tapered conductors. One course. (3 graduate units.) *Muga*

**222. Open Channel Flow.** Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. One course. (3 graduate units.) *Muga*

**223. Flow Through Porous Media.** Theory of miscible and immiscible fluid displacement processes. Derivation and solution methods. Selected problems in stability, fingering, and capillarity. Applications; saline water intrusion, secondary recovery processes, seepage through earthen dams, dewatering of construction sites, and well point operation. One course. (3 graduate units.) *Muga*

**224. Coastal and Offshore Engineering.** Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave

spectra. Effects of waves on structures emphasizing design of marine facilities and other selected problems. One course. (3 graduate units.) *Muga*

**225. Engineering Hydrology.** Study of processes governing the origin, distribution, and depletion and replenishment of water resources, and application of this knowledge to the solution of water supply and drainage problems. Topics include the hydrologic cycle, hydrometeorology, precipitation runoff, hydrograph analysis, evapotranspiration, infiltration, groundwater, runoff, stream flow, groundwater recharge, and hydrologic measurements. One course. (3 graduate units.) *Muga*

**231. Structural Engineering Analysis.** The analysis of fundamental structural forms including arches, suspension cables and members of variable inertia. Influence lines for indeterminate structures. Introduction to matrix analysis. Prerequisites: Civil Engineering 131 and Mathematics 104, or consent of instructor. One course. (3 graduate units.) *Brown*

**232. Reinforced Concrete Design.** A critical review of research related to the development of existing codes. Special attention is given to the consideration of temperature change effects, shrinkage, plastic flow, bond, and shear and diagonal tension. Two-way slab and flat plate design. Prerequisite: Civil Engineering 133. One course. (3 graduate units.) *Brown*

**233. Prestressed Concrete Design.** A critical review of research and recent developments in prestressed concrete design. Prestressed tanks, beams, and columns; partial prestressing and composite design. Prerequisite: Civil Engineering 133. One course. (3 graduate units.) *Brown*

**234. Structural Design in Metals.** Design of metal structures using both elastic and plastic theories. Application to plate girders, bridge trusses, and building frames. Interpretation and justification of building codes and specifications. Planning, preliminary design, and organization of design procedures. Prerequisite: Civil Engineering 134. One course. (3 graduate units.) *Palmer*

**235. Foundation Engineering.** An introduction to methods of analysis, design, and construction of foundations. Bearing capacity and settlement of shallow and deep foundations. Soil exploration; excavation and bracing; drainage and stabilization; and underpinning. Foundation vibrations. One course. (3 graduate units.) *Vesic*

**236. Earth Structures.** An introduction to methods of analysis, design, and construction of earth structures such as dams, embankments, cuts, canals, and airfield and highway pavements. Selection of materials, soil compaction, and stabilization. Theory of seepage, design of wells and drainage collectors. Slope stability and related problems. Theory of layered systems and pavement design procedures. One course. (3 graduate units.) *Tusi*

**238. Rock Mechanics.** Behavior and properties of rock as an engineering material; failure of rock. Design and construction of underground structures and slopes in rock; design of rock abutments for dams. Laboratory and field rock testing techniques. Prerequisite: Civil Engineering 139 or consent of instructor. One course. (3 graduate units.) *Staff*

**241. Environmental Engineering Chemistry and Biology.** Inorganic and organic chemistry as applied to water and wastewater treatment. Chemical equilibria and kinetics. Population dynamics and energy transfer in metabolic systems. Instrumental analysis, including spectrophotometry, chromatography, and atomic adsorption. Atmospheric chemistry and analytical methods. Prerequisite: Civil Engineering 124. One course. (3 graduate units.) *Vesilind*

**243, 244. Sanitary Engineering Unit Operations and Process Design.** Fundamental bases for design of water and waste treatment systems, including transport, mixing, sedimentation and filtration, gas transfer, coagulation, and biotreatment processes. Prerequisite: Civil Engineering 124 or consent of instructor. Two courses. (6 graduate units.) *Vesilind*

**246. Sanitary Engineering Design.** The study of water resources and municipal water requirements including reservoirs, transmission, treatment and distribution systems; methods of collection, treatment and disposal of municipal and industrial wastewaters. The course includes the preparation of a comprehensive engineering report encompassing all aspects of municipal water and wastewater systems. Field trips to be arranged. Prerequisite: Civil Engineering 124 or consent of instructor. One course. (3 graduate units.) *Rimer and Vesilind*

**247. Air Pollution control.** The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods. Noise pollution, odor, and air pollution law. One course. (3 graduate units.) *Vesilind*

**248. Solid Waste and Resource Recovery Engineering.** Engineering design of resource recovery systems including traditional and advanced technologies. Sanitary landfills and incineration of solid wastes. Energy recovery and recycling municipal refuse. Collection, treatment, and disposal of solid wastes from wastewater treatment. Prerequisite: Civil Engineering 124 or consent of instructor. One course. (3 graduate units.) *Rimer and Vesilind*

**249. Resource Recovery Systems Management.** The social, economic, legal, political, and administrative aspects of resource recovery from municipal solid wastes. Economic applications and systems management. Assessment methodologies. Federal and state legislation. Public versus private sector interests. Policy issues. Case studies. Prerequisite: consent of instructor. One course. (3 graduate units.) *Dajani and Warner*

**250. Engineering Analysis.** Formulation of mathematical models selected from a wide variety of engineering disciplines; optimization; use of infinite series, finite difference calculus, energy methods, and digital computers as problem-solving techniques. One course. (3 graduate units.) *J. F. Wilson*

**251. Systematic Structural Analysis I.** Computer analysis techniques for the equilibrium problems of solids and structures. Describing the problems to a digital computer. Transformation matrices. Recapitulation of energy theorems. Stiffness and flexibility relations of structural elements in discrete space and continuum. Systematic analysis of equilibrium problems by displacement and force methods. Errors. Prerequisites: Mathematics 104, and Civil Engineering 131 or Engineering 135, or consent of instructor. One course. (3 graduate units.) *Utku*

**252. Systematic Structural Analysis II.** Computer analysis techniques for the equilibrium, eigenvalue and propagation problems of solids and structures. Representation of initial stresses. Handling of geometrical nonlinearities in equilibrium problems. Buckling. Handling of material nonlinearities. Incremental load techniques. Time dependent materials. Representation of inertial and damping forces. Stationary and transient vibrations. Random vibrations. Prerequisite: Civil Engineering 251 or consent of instructor. One course. (3 graduate units.) *Utku*

### Departmental Major in Civil Engineering

The major requirements are included in the minimum total of thirty-two



courses listed under the general requirements and departmental requirements. Specific courses which must be included are: Engineering 11 (half course), 51, 75, 83, 123, 145; Civil Engineering 16 (half course), 116, 123, 124, 131, 134, and 139.

## ELECTRICAL ENGINEERING

Associate Professor Hacker, *Chairman*; Associate Professor Joines, *Director of Undergraduate Studies*; Professors Artley, Kerr, Marinos, Nolte, Owen, Pilkington, Thurstone, Wang, and Wilson; Assistant Professors George and Shubert

Electrical Engineering is a broadly based discipline dealing with the processing, control, and transmission of information and energy by making use of the electrical and magnetic forces of nature. A partial listing of technical programs possible under the electrical engineering curriculum at Duke follows: communication systems, computer systems design, information science, electronics-networks, electromagnetics, physical electronics, control systems, energy conversion, applied mathematics, and applied physics. Students with interests such as premedicine, prelaw, computer science, management, economics, art and music, psychology and social systems may also be accommodated within the curriculum. These programs are individually designed and, in addition to stressing the acquisition of specific skills and methods, seek in both the classroom and laboratory to stimulate students to think creatively in terms of fundamental concepts.

Opportunities for research and project work are available in the following research and teaching laboratories: The Solid State Sciences Laboratories are concerned with both the microscopic and macroscopic properties of materials with emphasis on electric and magnetic phenomena such as magnetic susceptibility, paramagnetic resonance, electrical conductivity, and magnetic ordering transitions. In the Thin-Films Laboratory investigations are directed toward physical properties of thin films which provide bases for applications in electronic and computer systems. In the Field and Matter Interaction Laboratory studies are being conducted to determine the nature of stimulated and spontaneous electromagnetic radiation from organic materials. The Electronics Laboratory is used for the study of the physical behavior of basic electronic components and of advanced electronic devices and circuits. The Energy Conversion Laboratory is concerned with the generation, transformation, and control of energy in large-scale power systems and small self-contained systems. The Automatic Control Systems Laboratory deals with the principles underlying instrumentation and control of physical processes. The Spacecraft Systems Laboratory combines all phases of electrical engineering in solving problems encountered in modern spacecraft technology. The Controlled Personal Environment Laboratory provides experimental learning activities directed to the understanding of the self and the interaction of the self with others and a carefully controlled physical environment. The Machine Intelligence Laboratory is concerned with the design of adaptive and learning control systems for various applications. In the Electromagnetic Waves Laboratory studies are made on microwave networks and the interaction of electromagnetic waves with biological systems. The Minicomputer Laboratories provide the opportunity for hands-on experience in the operation of two small computers in an instructional and research environment. The Digital Systems Laboratories are utilized for research and instruction in digital systems design and simulation. The Adaptive Information Processing Laboratory is concerned with the formulation and performance evaluation of adaptive algorithms for extracting signals and information from noise.

**11, 12. Undergraduate Research in Electrical Engineering.** An elective pro-



gram in which undergraduate students participate in an ongoing program of research with electrical engineering faculty members. The research topic pursued by the student is arranged by mutual agreement between the student and the participating faculty member. For freshmen only. Fall and spring semesters. Quarter course. *Staff*

**42. Introduction to Digital Systems.** A course designed for students who have no previous exposure to switching (Boolean) algebra. Its main objective is to introduce basic notions of switching algebra and to demonstrate the application of these concepts to digital systems design. The operational characteristics of major digital subsystems such as memories, central processing elements, arithmetic units, and input-output devices are discussed in detail, and a general-purpose digital computer system with a simple architecture is functionally analyzed. Selected laboratory work is required. Fall and spring semesters. (Also listed as Computer Science 42.) One course. *Marinos or Owen*

**43. Electronic Instruments and Devices.** The theory of operation and applications of electronic instruments and devices most commonly used by scientists and engineers are presented. Topics include: d.c. and a.c. circuits, transducers, measurements, diode and transistor applications, operational amplifiers, and radiation detectors and generators. Three class sessions and one computation or laboratory session. Prerequisite: Mathematics 31. May not be taken concurrently with or after Electrical Engineering 63. Spring semester. One course. *Joines*

**51, 52. Undergraduate Research in Electrical Engineering.** For sophomores only. See Electrical Engineering 11, 12. Fall and spring semesters. Quarter course. *Staff*

**63. Electric Networks.** The physical basis for electrical network models. Conductors and semiconductors; energy storage elements. Network topology and equations. Transient response due to initial conditions and step function inputs. Exponential forcing functions and the sinusoidal steady state. System functions; network theorems; power and energy in steady state circuit analysis. Prerequisites: Mathematics 32 and Physics 51 or consent of the instructor. Fall and spring semesters. One course. *Kerr or Wang*

**101, 102. Undergraduate Research in Electrical Engineering.** For juniors only. See Electrical Engineering 11, 12. Fall and spring semesters. Quarter course or half course. *Staff*

**103. Introduction to Nonlinear Network Theory.** Introduction to theory and techniques for analysis and synthesis of nonlinear circuits. Characterization of 2-, 3-, and n-terminal nonlinear network elements. Laws for interconnecting elements and determining equilibrium equations. Operating points, driving-point and transfer-characteristics plots. Graphical and numerical analysis and synthesis of d.c. and a.c. nonlinear resistive functional networks. Nonautonomous first-order nonlinear networks, and autonomous second-order nonlinear networks. Method of isoclines. Some laboratory and computer simulations. Prerequisite: Electrical Engineering 63. Fall semester. One course. *Wilson*

**113. Introductory System Theory.** Fourier series. Fourier and Laplace transforms; transfer function analysis. Impulse functions; impulse response of systems; convolution and time domain analysis. Discrete time models and computer simulation of continuous systems. Multiple input-output systems; introduction to state variable analysis. Prerequisites: Electrical Engineering 63. Fall and spring semesters. One course. *Kerr or Wang*

**143. Introduction to Electromagnetic Fields.** Review of vector analysis. In-

roduction to Maxwell's equations. Electrostatic and magnetostatic fields and their sources. Electromagnetic power, energy, and the Poynting theorem. Prerequisites: Mathematics 104 or 111 and Physics 52. Fall semesters. One course. *Hacker or Joines*

**151, 152. Undergraduate Research in Electrical Engineering.** For seniors only. See Electrical Engineering 11, 12. Fall and spring semesters. Quarter or half course. *Staff*

**155, 156. Special Topics in Electrical Engineering.** Study of selected topics in electrical engineering tailored to fit the requirements of a small group. Prerequisites: consent of the Director of Undergraduate Studies and the instructor. Each half course or one course. *Staff*

**157. Introduction to Switching and Automata Theory.** This course introduces techniques for the analysis and design of combinational and sequential networks. Discrete mathematical systems; elements of code theory; threshold logic; functional decomposition; minimum-complexity combinational and sequential networks; asynchronous and clocked sequential systems; iterative switching structures; Turing machines; and fault diagnosis techniques. Selected laboratory work. Usually open to juniors and seniors. Fall semester. (Also listed as Computer Science 157.) One course. *Marinos*

**161. Electronic Circuits.** Graphical and mathematical modeling of electronic devices such as diodes, bipolar-junction and field-effect transistors, and vacuum tubes; techniques for the analysis and design of electronic circuits with emphasis on graphical, piece-wise linear, and small-signal methods; applications of these methods to particular circuits, including regulators, bias-point stability, amplifiers, and switching circuits; computer simulation of electronic circuits using ECAP. Three class sessions and one computation or laboratory session. Prerequisite: Electrical Engineering 63. Spring semester. One course. *Wilson*

**162. Electromechanical Energy Conversion.** Principles of energy storage and conversion utilizing magnetic and electric fields; analytical treatment of dynamic equations of motion, including the Euler-Lagrange approach; applications to the design of electromechanical transducers and rotating machines. Three class sessions and one laboratory. Prerequisite: Electrical Engineering 113. One course.

**164. Electromagnetic Fields and Waves.** Discussion of plane waves in insulating and conducting media. Reflection and refraction of plane waves. Transmission lines and waveguides for practical applications. Introduction to radiation and antennas. Prerequisite: Electrical Engineering 143. One course. *Joines or Hacker*

**173, 174. Projects in Electrical Engineering.** A course which may be undertaken only by seniors who are enrolled in the Graduation with Distinction Program, or who show special aptitude for individual project work. Prerequisite: consent of the Director of Undergraduate Studies. Elective for electrical engineering majors. Half course to two courses. *Staff*

**185. Pulse and Digital Electronics.** Generation and shaping of waveforms encountered in information processing systems, such as radar, computer, control, and instrumentation. Typical circuit functions included are linear and non-linear wave shaping, pulse and time-base generation, time delay, counting, and gating. Emphasis on the application of semiconductor devices to the realization of circuit functions. Three class sessions and one computation or laboratory session. Prerequisite: Electrical Engineering 161. One course. *George*

**186. Modulation Systems and Noise.** Analysis and design of modulation systems. Description of deterministic and probabilistic signals; power spectra; sampling theory; amplitude-, frequency-, and pulse-modulation systems, and pulse-modulation techniques; comparison of various modulation systems. Selected laboratory work. One course. *Nolte or Owen*

**188. Dynamics of Electrochemical Energy Conversion.** An analytical and experimental study of the dynamic characteristics of electromechanical energy conversion devices that are utilized in both control and power applications. Three class sessions and one three-hour laboratory. Prerequisite: Electrical Engineering 162. One course.

**196. Microwaves and Quantum Electronics.** A study of the special field and circuit techniques required at microwave frequencies; electromagnetic wave propagation in unbounded and bounded media; transmission and reflection properties of various microwave networks. Equivalent circuits and matrix methods will facilitate analysis. Discussion of microwave amplifiers and oscillators, including klystrons, magnetrons, traveling-wave tubes, and masers. Selected laboratory experiments. Three class sessions and one computation or laboratory. Prerequisite: Electrical Engineering 164. One course. *Joines*

**199. Linear Control Systems.** Analysis and design of feedback control systems. Block diagram and signal flow graph system models. Servomechanism characteristics; steady state errors; sensitivity to parameter variations and disturbance signals. Time domain performance specifications. Stability. Root locus, Nyquist, and Bode analysis; design of compensation circuits; closed loop frequency response determination. Introduction to time domain analysis and design. Prerequisite: Electrical Engineering 113 or consent of instructor. Spring semester. One course. *Kerr or Wang*

**203. Random Signals and Noise.** Introduction to mathematical methods of describing and analyzing random signals and noise. Review of basic probability theory; joint, conditional, and marginal distributions; random processes. Time and ensemble averages, correlation, and power spectra. Optimum linear smoothing and predicting filters. Introduction to optimum signal detection and parameter estimation. Fall semester. (Also listed as Computer Science 203.) One course. (3 graduate units.) *Kerr or Nolte*

**204. Information Theory and Communication Systems.** Information and entropy and their application in communication situations. Noise and channel capacity, coding, and the fundamental theorem of information theory. Continuous channels and transmission of band-limited signals. Comparisons of various practical modulation techniques from the standpoint of information rate and error probability. Spring semesters, 1976, 1978. Prerequisite: Electrical Engineering 203. One course. (3 graduate units.) *Marinos or Nolte*

**205. Signal Detection and Extraction Theory.** Introduction to signal detection and information extraction theory from a statistical decision theory viewpoint. Subject areas covered within the context of a digital environment are decision theory, detection and estimation of known and random signals in noise, estimation of parameters and adaptive recursive digital filtering, and decision processes with finite memory. Applications to problems in communication theory. Spring semester. (Also listed as Computer Science 205.) Prerequisite: Electrical Engineering 203 or consent of instructor. One course. (3 graduate units.) *Nolte*

**206. Digital Signal Processing.** Introduction to the fundamentals of processing signals by digital techniques with applications to practical problems. Dis-



crete time signals and systems, elements of the z-transform, discrete Fourier transform, digital filter design techniques, fast Fourier transform, and discrete random signals. Spring semester. One course. (3 graduate units.) *Nolte*

**208. Digital Computer Design.** Hardware implementation of combinational and sequential switching networks. Arithmetic elements, switching matrices, character generators, counters, and shift registers. Detailed design and simulation of a general-purpose computer system. Computer architectures based on macromodules, hardware compiler implementations, and parallel processing concepts are also discussed. Prerequisite: Electrical Engineering 157 or consent of instructor. Spring semester. (Also listed as Computer Science 208.) One course. (3 graduate units.) *Marinos or Owen*

**211. Solid State Theory.** A treatment of postulatory quantum mechanics and statistical mechanics to serve as a background for the solid state sciences. Topics include both the Schrodinger and matrix formulations, angular momentum, perturbation methods, Maxwell-Boltzmann and Fermi distributions. Prerequisite: consent of instructor. Fall semester. One course. (3 graduate units.) *Artley or Hacker*

**212. Solid State Materials.** Concepts of solid state physics as applied to engineering materials; electric magnetic, thermal, and mechanical properties of solids; dielectrics; semiconductors; magnetic materials; superconductors. Prerequisite: Electrical Engineering 211. Spring semester. One course. (3 graduate units.) *Artley or Hacker*

**213. Principles of Magnetism.** A discussion of the various classes of magnetic materials including diamagnets, paramagnets, ferromagnets, antiferromagnets, and ferrimagnets. Typical topics include: crystal field effects, exchange interactions, domain formation, and resonance phenomena. Prerequisite: consent of instructor. One course. (3 graduate units.) *Artley or Hacker*

**215. Semiconductor Physics.** A quantitative treatment of the physical processes that underlie semiconductor device operation. Topics include: band theory and conduction phenomena; equilibrium and nonequilibrium charge carrier distributions; charge generation, injection, and recombination; drift and diffusion processes. Prerequisite: Electrical Engineering 211 or consent of instructor. One course. (3 graduate units.) *Hacker*

**217. Masers.** Principles of masers, particularly optical masers. Discussion of quantum electronics, optical configuration; solid state, gaseous, and liquid devices; modulation; high power operation. Prerequisite: consent of instructor. Some laboratory work. Spring semesters, 1977, 1979. One course. (3 graduate units.) *George*

**221. Nonlinear Networks and Systems.** Characterization of nonlinear multi-terminal network elements, formulation of system equations from topological and energy considerations. Basic properties and general methods of solution of resistive nonlinear networks. Time-varying linear systems. Examination of some fundamental properties of nonlinear differential equations. Spring semester. One course. (3 graduate units.) *Wilson*

**222. Nonlinear Analysis.** Introduction to methods of analyzing engineering systems described by nonlinear differential equations: analytic, numerical, graphical, and series approximation methods; analysis of singular points; stability of nonlinear systems. Applications of various methods, such as the modified Euler, Runge-Kutta, isoclines, perturbation, reversion, variation of parameters, residuals, harmonic balance, Bendixon, and Liapounov to phenomena



of nonlinear resonance, subharmonics, relaxation oscillations, and forced oscillating systems. Fall semester. (Also listed as Mechanical Engineering 232.) One course. (3 graduate units.) *Wilson*

**224. Integrated Electronics: Analog and Digital.** Application of integrated circuits for analog and digital systems. Topics include the effect of fabrication techniques on circuitry design, a study of differential and operational amplifiers, and consideration of various logic families such as resistor-transistor logic (RTL), diode-transistor logic (DTL), current-mode or emitter-coupled logic (ECL), and transistor-transistor logic (TTL). Prerequisite: Electrical Engineering 161 or equivalent. Fall semester. One course. (3 graduate units.) *Wilson*

**225. Semiconductor Electronic Circuits.** Analysis and design of electronic circuits utilizing a variety of static and dynamic models of semiconductor devices. Transistor and other semiconductor device circuit models; bias stability; high frequency and noise models; switching characteristics; illustrative semiconductor circuits. Selected laboratory work. Spring semester. Prerequisite: consent of instructor. One course. (3 graduate units.) *Joines*

**227. Network Synthesis.** Linear network theory, including a review of time and frequency domain analysis; network graphs; network functions and realizability condition; driving point impedance synthesis of passive networks; driving point and transfer specifications; approximation methods. Fall semesters, 1975, 1977. Prerequisite: consent of instructor. One course. (3 graduate units.) *George*

**241. Linear Systems.** Modeling of multiple input-output linear systems in the frequency and time domains. Matrix differential and difference equations and their solutions; state variables. Digital simulation of differential systems. Fourier analysis of signals and systems. Transform techniques applied to state variable models. State space models of distributed systems. Fall semester. One course. (3 graduate units.) *Kerr or Wang*

**242. Modern Control and Dynamic Systems.** See course description for Mechanical Engineering 230. (Also listed as Mechanical Engineering 230.) One course. (3 graduate units.) *Wright*

**243. Advanced Linear Systems Theory.** Linear spaces and linear operators. Impulse-response matrices. Controllability and observability. Irreducible realizations of rational transfer function matrices. Canonical forms, state estimators, and observer theory. Stability. Linear time-invariant composite systems. Prerequisite: Electrical Engineering 241. Spring semesters, 1976, 1978. One course. (3 graduate units.) *Kerr or Wang*

**251. Pattern Classification and Recognition.** Parameter estimation and supervised learning; nonparametric techniques; linear discriminant functions; clustering; language theory related to pattern recognition and syntactic pattern recognition; examples such as characters, severe weather recognition and classification of community health data, etc., are discussed. Prerequisite: consent of instructor. Spring semesters 1976, 1978. One course. (3 graduate units.) *Wang*

**265. Advanced Topics in Electrical Engineering.** Opportunity for study of advanced subjects related to programs within the Electrical Engineering Department tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate Studies and of instructor under whom work will be done. One course. (1 to 3 graduate units.) *Staff*

**266. Biofeedback Systems.** Instrumentation, on-line computer analysis, and models associated with biofeedback systems. Selected readings will be con-

sidered in conjunction with experience in laboratory feedback practices. The physical, physiological, and psychological aspects of biofeedback provide a vehicle for experiential learning which relates individual experience to models used in systems theory, field theory, electronics, and communications. Undergraduate electrical engineering majors may not use this course as one of their four electrical engineering elective courses. Prerequisite: consent of instructor. Spring semester. One course. (3 graduate units.) *Artley*

**271. Electromagnetic Theory.** The classical theory of Maxwell's equations; electrostatics, magnetostatics, boundary value problems including numerical solutions, currents and their interactions, and force and energy relations. Three class sessions. Fall semester. Prerequisite: consent of instructor. One course. (3 graduate units.) *Joines*

**272. Application of Electromagnetic Theory.** Propagation of electromagnetic waves in various structures and media; mathematical description of microwave networks, including equivalent circuits and matrix methods; microwave circuit theorems and synthesis techniques. Selected laboratory experiments. Spring semesters 1976, 1978. Prerequisite: Electrical Engineering 271. One course. (3 graduate units.) *Joines*

### **Departmental Major in Electrical Engineering**

The major requirements are included in the minimum total of thirty-two courses listed under the general requirements and departmental requirements. The specific courses Electrical Engineering 63 and 113 must be included.

## **MECHANICAL ENGINEERING AND MATERIALS SCIENCE**

Professor Chaddock, *Chairman*; Associate Professor Shepard, *Director of Undergraduate Studies*; Professors Clark, Garg, Harman, Linderth, Macduff, and Pearsall; Adjunct Professor Roberts; Associate Professors Cocks, Elsevier, and Wright; Adjunct Associate Professor Mayer; Assistant Professors Buzzard, Johnson, and Shaughnessy

In a modern technological society the profession of mechanical engineering has a three-fold role. The first, and traditional role, is the production of devices and machines. The products are as varied as the needs of mankind, from a mechanical toothpaste tube filler to a hydraulic turbine for harnessing tidal power or a home heating system powered by solar energy. The second role has gradually evolved from the first, and now encompasses indepth technical analyses and the design of complex engineering systems. Examples are nuclear power stations and ocean habitats for undersea exploration. The third role involves the relationship between technological change and man's social, biological, and physical environment. It is no longer adequate to consider only obvious benefits and immediate costs; engineering solutions must be related to society's nontechnical needs and problems. If an educational program is to provide engineering leaders, it must respond to these broadening roles.

Historically, the available materials have limited the technological development of any age. The development of materials with particular combinations of mechanical, chemical, and electrical properties continues as a limiting step for technological advances on almost every engineering frontier. An especially crucial area requiring the skills of materials scientists and engineers is that of energy conversion. Needs exist not only in the overall production, distribution, and use of energy itself, but also in the development of less energy-consuming processes for the production of materials.

The undergraduate curriculum in mechanical engineering and materials

science provides a broad base in the basic sciences and mathematics, engineering and materials sciences, analog and digital computation, mechanical design, systems theory, and engineering applications involving analysis, synthesis, and design. The search for viable solutions to mankind's problems also requires an engineer to interact with other professions and disciplines; to reach out for an understanding of the economic, social, health, and political consequences of engineering decisions. Elective opportunities in the social sciences, life sciences, and humanities help fill this need.

Undergraduate laboratories provide unique learning experiences and assist in the development of professional attitudes and approaches to typical engineering problems. In the System Dynamics Laboratory, fundamentals of instrumentation and dynamic responses are introduced through simulation techniques. The Materials Laboratory has equipment for the synthesis and evaluation of metals, polymers, ceramics, and biomaterials. Experiments in the Fluid Mechanics and Heat Transfer Laboratories relate velocity and temperature field measurements to fluid friction and heat exchange processes. In the System Response and Control Laboratory, computer simulation of feedback systems and familiarization with automatic control of hydraulic and pneumatic components is emphasized.

Involvement with mechanical engineering and materials science goes beyond any specific technology, device, or system. Based on the curriculum, the student will experience the ways in which scientific knowledge can be utilized in the design and development of useful devices and processes. With the curriculum flexibility and the variety of course offerings, each student can choose a course of study most suited to his or her aptitude.

**65. Introduction to Energy Technology.** The objectives of this course are to survey the whole field of energy conservation and control, and to stimulate the student into thinking creatively and inventively about energy technology. Topics to be covered include: the energy crisis; energy sources and uses; thermodynamics, engineering approaches to energy conversion, nuclear and fossil fuel power plants; new energy technologies including solar, geothermal, wind, and tidal; transportable energy sources and energy storage systems. One course. *Chaddock, Cocks, Harman, and Shepard*

**102. Thermodynamics II.** Review of the laws of thermodynamics and some of their consequences relative to energy conversion. Statistical concepts of the second law. Properties of real gases, gas mixtures, and solids. Generalized thermodynamic relationships. Combustion, thermochemistry, and chemical equilibrium. Applications to combustion power cycles, propulsion, and heat pumping. Prerequisite: Mechanical Engineering 101. One course. *Elsevier*

**111. Physical Metallurgy.** Extension of the principles of Engineering 83 to the metallic state; atomic, experimental, and thermodynamic approaches to metallurgy; phase transformations and hardening mechanisms, relationships between the structure of alloys and plastic behavior with emphasis on engineering alloy systems. Prerequisite: Engineering 83. One course. *Cocks, Pearsall, or Shepard*

**112. Polymer Science.** Extension of the principles of Engineering 83 to high molecular weight polymers, especially those which have significant engineering applications; structure and properties of polymers; polymerization mechanisms; properties of commercial polymers; polymer processing. Prerequisite: Engineering 83. One course. *Clark or Pearsall*

**113. Materials Science and Energy Technology.** The limitations imposed by materials problems on the development of new energy technologies. Nuclear



power and thermonuclear fusion, solar power, magnetohydrodynamics, fuel cells superconducting electric power generators, and geothermal systems will be studied together with the materials limitations of magnetic, dielectric, mechanical, and gaseous fuel energy storage methods. The role of materials technology in increasing the efficiency of conventional conversion methods will also be included. Prerequisite: Engineering 83 or Mechanical Engineering 65. One course. *Cocks and Shepard*

**123. Dynamics.** General principles of dynamics as applied to particles, rigid bodies, and selected nonrigid systems with emphasis on the formulation of engineering problems. Absolute and relative motion analysis. Work-energy and impulse-momentum methods. Introduction to kinematics and kinetics in three dimensions and to Lagrange's equations using generalized coordinates. Prerequisites: Physics 51, Mathematics 103, and Engineering 75. One course. *Macduff or Wright*

**126. Fluid Mechanics.** An introductory course emphasizing the application of the principles of conservation of mass, momentum, and energy to a fluid system. Physical properties of fluids; dimensional analysis and similitude, viscous effects and integral boundary layer theory; subsonic and supersonic flows; normal shock waves. Selected laboratory work. Corequisites: Mechanical Engineering 123 and 101. One course. *Shaughnessy*

**135. Vibration Control.** An introduction to the dynamics of mechanical systems; equilibrium, stability, and lumped and distributed systems. System analysis by classical differential equations, mechanical impedance, and computer methods. Prerequisites: Mathematics 103 and Engineering 72. One course. *Macduff*

**136. Response of Systems.** System design for optimum dynamic response. Development of mathematical models from physical systems, operational and computer techniques, matrix methods for lumped and distributed systems, instrumentation and testing of components and systems, effect of nonlinearities. Prerequisites: Mathematics 111, Mechanical Engineering 123, and Engineering 72. One course. *Macduff or Wright*

**141. Mechanical Design I.** A study of the broad aspects of mechanical design starting with the creative process and considering the effects of economics, human factors, ethics, and prior art on design. Basic mechanical components such as gears, cams, bearings, springs, shafts, etc. will be introduced in the discussions so that the student will become familiar with their design and application. A term design project will serve to practice the application of the design process. Prerequisite: Mechanical Engineering 123. One course. *Linderoth or Roberts*

**142. Kinematics and Dynamics of Machinery.** Study of the geometry of mechanisms. An introduction to the mathematics of gears, cams, linkages, and intermittent motion devices. The kinematics of linkages. Computer solutions for linkage problems. Prerequisite: Mathematics 103. Corequisite: Engineering 123. One course. *Linderoth*

**143. The Design of Machine Elements.** The detail design of machine elements. Study of the problems of stress and strain (deflections) as they affect and modify design requirements. Reliability and safety as design parameters. Prerequisite: Mechanical Engineering 141. One course. *Linderoth*

**150. Heat and Mass Transfer.** A rigorous development of the laws of mass and energy transport as applied to a continuum. Energy transfer by conduction, in laminar and turbulent flow inside and outside of tubes, and by radiation.



Application to heat exchangers, thermal power equipment, and heat transfer in the environment. Introduction to the principles of molecular diffusion and convective mass transfer. Use of the analogies between mass, momentum, and energy transfer in problem solving. Selected laboratory work. Prerequisites: Mechanical Engineering 126 and Mathematics 111. One course. *Buzzard or Chad-dock*

**153. Heating, Air Conditioning, and Refrigeration.** Principles of thermodynamics, heat transfer, and fluid flow applied to comfort and industrial air conditioning. Cycles and equipment for heating, cooling, and humidity control. Air transmission and distribution. Modern vapor compression, absorption, and low temperature refrigeration cycles and systems. Prerequisite: Mechanical Engineering 101. One course. *Elsevier*

**156. Combustion Engines.** A study of cycles, fuels, and fuel mixtures in piston, ram jet, and rocket engines. Comparison of real and theoretical cycles; carburetion and fuel injection systems; and modern developments. Prerequisite: Mechanical Engineering 101. One course. *Elsevier*

**165, 166. Special Topics in Mechanical Engineering.** Study arranged on a special engineering topic in which the faculty has particular interest and competence as a result of research and professional activities. Prerequisites: consent of the instructor and the Director of Undergraduate Studies. Each half course or one course. *Staff*

**173. Ocean Engineering.** An introductory course to acquaint the student with the basics of physical and chemical oceanography and the need for and application of engineering knowledge and methods to the design and operation of structures, vehicles, and communications systems for use on and in the oceans. Prerequisite: junior standing in any department. (Also listed as Civil Engineering 173.) One course. *Linderoth and Muga*

**177. Computer Techniques for Simulation and Design.** Optimization methods for engineering design. Unconstrained and constrained minimization procedures with linear programming shown as a special case of the gradient projection method. Computer solutions and design projects emphasized. One course. *Wright*

**182. Fundamentals of Nuclear Engineering.** Review of nuclear physics, nuclear interactions and cross sections, neutron induced chain reactions, shielding, hazards, isotope utilizations, reactor systems, and power reactors. Prerequisite: consent of instructor. One course. *Staff*

**183. Power Plants.** Basic concepts of thermodynamics, heat transfer, and fluid flow are combined with industrial data for the consideration of real power plant problems. Selection of steam generators, prime movers, fans, pumps, heaters, and piping systems with regard to engineering, economic, and environmental points of view. One course. *Harman*

**197, 198. Projects in Mechanical Engineering.** This course may be assigned by the chairman of the department to outstanding seniors who express a desire for such work and who have shown aptitude for research in one distinct field of mechanical engineering. Prerequisites: *B* average and senior standing. Half course to two courses. *Staff*

**202. Theoretical Thermodynamics.** Review of classical thermodynamics. Thermodynamics of continuum properties of real substances. Analysis of energy conversion with internal irreversibility and advanced engineering problems. Introduction to the statistical basis of thermodynamics. One course. (3 graduate units.) *Harman*

**209. Structural Dynamics.** (Also listed as Civil Engineering 209.) One course. (3 graduate units.) *J. F. Wilson*

**210. Intermediate Dynamics.** Comprehensive treatment of space kinematics, kinetics of particles and rigid bodies; generalized coordinates and Lagrange's equations; introduction to stability and random dynamic analysis of flexible, continuous systems. ((Also listed as Civil Engineering 210.) One course. (3 graduate units.) *Macduff or J. F. Wilson*

**211. Theoretical and Applied Polymer Science.** An advanced course in materials science and engineering, dealing specifically with the structure and properties of polymers. Particular attention is paid to recent developments in the processing and use of modern plastics and fibers. Product design is considered in terms of polymer structures, processing techniques, and properties. One course. (3 graduate units.) *Clark or Pearsall*

**213. Advanced Materials Science.** An indepth study of current problems in materials applications conducted in a seminar format. Treatment will include thermal, electrical, optical, and magnetic properties of materials in terms of basic physical concepts. Subjects intended to provide materials scientists and engineers with a theoretical basis for understanding and manipulating properties. Prerequisite: Engineering 83 and Mechanical Engineering 111 or 112. One course. (3 graduate units.) *Cocks, Pearsall, or Shepard*

**214. Corrosion and Corrosion Control.** Effects of environments on the design and utilization of modern engineering alloys. Theory and mechanisms of corrosion, particularly in seawater and atmospheric environments. Microstructural aspects of diffusion, oxidation, hot corrosion, and stress corrosion. Prerequisite: Engineering 83. One course. (3 graduate units.) *Cocks or Shepard*

**215. Failure Analysis and Prevention.** A study and analysis of the causes of failure in engineering materials and the diagnosis of those causes. Elimination of failures through proper material selection, treatment, and use. Case histories. Examination of fracture surfaces. Laboratory investigations of different failure mechanisms. Prerequisite: Engineering 83 or consent of instructor. One course. (3 graduate units.) *Cocks or Shepard*

**216. Materials Design and Resource Conservation.** The role of materials science and engineering in the field of resource conservation and recovery. Selection of materials for components of consumer products and equipment. Designing materials at atomic, molecular, and phase-structure levels to minimize energy consumption, optimize properties, and enhance recycling. Analysis of some constraints posed by thermodynamics, economics, raw material availability, and governmental policies. Prerequisite: Engineering 83. One course. (3 graduate units.) *Pearsall*

**221. Compressible Fluid Flow.** Basic concepts of flow of gases from the subsonic to the hypersonic regime. Effects of friction, heat transfer, and shock on one-dimensional inviscid flow. Potential theory, oblique shock waves, and special calculation techniques in two-dimensional flow. One course. (3 graduate units.) *Harman*

**222. Heat Transfer.** Steady-state and transient solutions of the general heat conduction equation. Development of the equations for transport of energy by fluid motion. Principle of similarity and dimensional analysis in convective energy transport. Solutions of the boundary layer equations. The laws of radiation heat transfer and radiation heat exchange. One course. (3 graduate units.) *Chaddock or Buzzard*

**224. An Introduction to Turbulence.** Flow instability and the transition to turbulence. Physical characteristics of turbulent flows, averaging, and the Reynolds equation. Turbulent transport and mixing length theories. The statistical description of turbulence, correlations, and spectra. Fourier transforms. Measurement techniques. One course. (3 graduate units.) *Shaughnessy*

**226. Intermediate Fluid Mechanics.** A survey of the principal concepts and equations of fluid mechanics. Fluid properties. Statics. Basic equations for the control volume. The differential equations of fluid motion. Stream function. Irrotational flow. Navier-Stokes equations. Kelvin's and Crocco's theorem. Applications to two-dimensional incompressible potential flow and to viscous flow in boundary layers. One course. (3 graduate units.) *Shaughnessy*

**230. Modern Control and Dynamic Systems.** The state-space point of view is used as a vehicle to integrate the classical control and modern systems techniques. Topics include vector differential equations, modal matrix transformations, modified canonical forms, and controllability and observability concepts. Also system stability and mathematical modeling methods for lumped- and distributed-parameter systems. Modal control of multivariable control systems. (Also listed as Electrical Engineering 242.) One course. (3 graduate units.) *Garg or Wright*

**231. Systems Response and Control.** Methods, applicable to design, of obtaining parameters for strength, response, and stability studies to mechanical systems. Analysis of closed loop control systems with linear transfer functions; electrical and mechanical analogs; introduction to determination of transfer function from input-output characteristics. One course. (3 graduate units.) *Macduff or Wright*

**232. Nonlinear Analysis.** Fall semesters. Prerequisite: consent of instructor. (Also listed as Electrical Engineering 222.) One course. (3 graduate units.) *T. Wilson*

**233. Fluid Control Systems.** A design oriented course concerned with hydraulic and pneumatic feedback control systems. Basic control system characteristics; linearized transfer functions; determination of transfer function from computation and experiment; position, velocity, and acceleration feedback devices; transducers; d.c. and a.c. hydraulic and pneumatic amplifiers. One course. (3 graduate units.) *Macduff*

**235. Advanced Mechanical Vibrations.** Analytical and experimental procedures applied to design of machines and systems for adequate vibration control. Determination of eigenvalues and eigenvectors by iteration and computer techniques; transfer matrices applied to lumped and distributed systems; analytical and numerical methods of obtaining the pulse response of plane and three dimensional multi-mass systems; convolution and data processing; introduction to random vibration. One course. (3 graduate units.) *Macduff*

**236. Engineering Acoustics and Noise Control.** Specification of the physical properties of noise, noise measurement, and absorption, transmission, and propagation of sound. Effects of noise on man, noise exposure, and damage risk criteria. Legal aspects of noise control, source modification, enclosures, barriers, and personnel protectors. Prerequisites: Mechanical Engineering 123 and Mathematics 111. One course. (3 graduate units.) *Macduff*

**251. Refrigeration and Cryogenics.** Theory and experiment in the evaluation of the thermodynamic properties of refrigerants and cryogenic fluids. Thermodynamics of vapor compression, air cycle, absorption, and thermo-

electric refrigeration. Production of low and very low temperatures, helium liquefiers. Two-phase flow processes. Heat exchange for refrigeration and cryogenic transfer. One course. (3 graduate units.) *Chaddock*

**255. Energy Conversion.** Principles, thermodynamics, and classification of energy conversion devices. Introduction to semiconductors, thermoelectric generators, photovoltaic generators, thermionic generators, magnetohydrodynamic generators, fuel cells, and other energy conversion devices. One course. (3 graduate units.) *Harman*

**265. Advanced Topics in Mechanical Engineering.** Opportunity for study of advanced subjects related to programs within mechanical engineering tailored to fit the requirements of a small group. Prerequisites: approval of the Director of Undergraduate or Graduate Studies and the instructor under whom work will be done. One course. (1 to 3 graduate units.) *Staff*

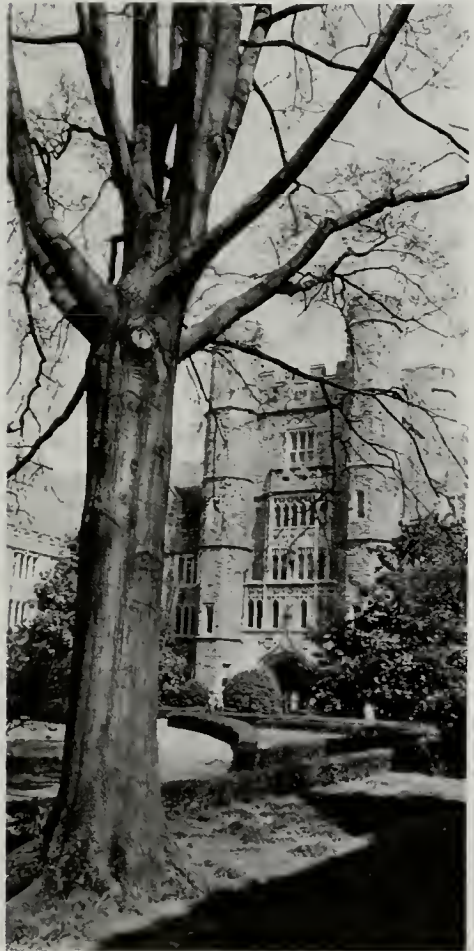
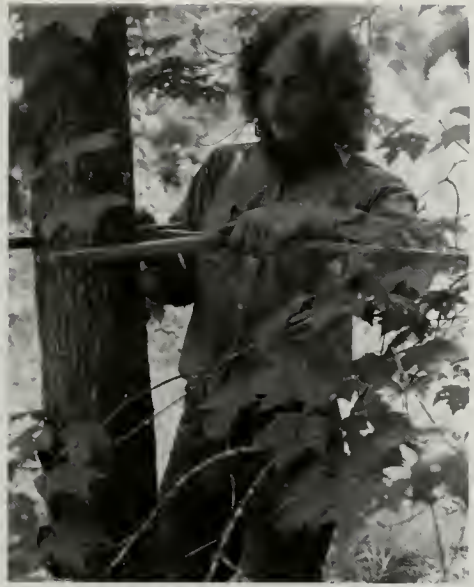
**270. Theory of Lubrication and Bearing Design.** A study and analysis of the theory of hydrodynamic and hydrostatic lubrication will be presented. The dynamics of bearing loading, bearing design, and materials will be examined in their relationships to the theory of lubrication. Properties of lubricants will be reviewed. The student will have ample opportunity to put theory into practice with real bearing problems taken from industrial machinery, construction equipment, transportation media, and wherever relative motion is required between adjacent surfaces. One course. (3 graduate units.) *Linderoth*

**280. Nuclear Reactor Power Cycles.** Basic reactor principles and types. Examination of most feasible thermodynamic cycles for use with both stationary and mobile power plants. Consideration of safety shielding, heat transfer, fluid flow, and materials problems unique to reactor design. One course. (3 graduate units.)

### **Departmental Major in Mechanical Engineering and Materials Science**

The major requirements are included in the minimum total of thirty-two courses listed under the general requirements and departmental requirements. Specific courses which must be included are: Engineering 72, 75, 83, and 101; Mechanical Engineering 123, 126, 136, 141, and 150.









# Appendix

## BACHELOR OF ARTS

Leigh Mary Ablondi  
Richard B. Abriss  
Anne Stokes Adams  
Marsha Lynn Adams  
Theodore David Aden  
Paul Miles Adler  
Lawrence Frederick Alexander  
Patricia Ann Allen  
Christopher Joseph Allwarden  
Faye L. Alston  
Elizabeth W. Ames  
Dale Watton Anderson  
James Scott Anderson  
Kay Elizabeth Anderson  
Robert Bruce Anderson  
William Arthur Anderson  
Frederick Henry Anlyan, Jr.  
Robert Arasi  
Wilma Padgett Armour  
David Raymond Arneke  
William Shapard Dowell Ashley  
Alison Louise Asti  
Robert Lee Atchison  
John Hugh Atkinson, Jr.  
Donna Marie Atwood  
Ellsworth Hunt Augustus  
George Randall Avery  
Arthur Emery Bailey  
Rhonda Yvonne Bailey  
James Stewart Bain  
Frank Weldon Baird  
Robert Charlton Baird  
Laura Elizabeth Baker  
Merl Wilson Baker  
Stephen Clinton Baker  
George Lyle Ball  
Margaret Tillman Ball  
Mark Byrd Ballard  
John William Barger, Jr.  
John Anton Barnet III  
Carl Erskine Barnett, Jr.  
Leecy Anne Barnett  
Mary Sue Barnett  
Jane Barnholdt  
George Britt Barr, Jr.  
William Christian Barrett  
Albert Armington Barrows III  
Jonathan Scott Bartels  
Rudy Michael Baum  
William Arthur Baxter  
Kenney Ray Beadles  
James Humphrey Becht  
Jeanne Elaine Beers  
Albert Fleming Bell II  
Susan Elizabeth Bello  
William Benda, Jr.  
Arlene Louise Bender  
Louisa Justice Benson  
Theodore Frederick Berg

Michael Laird Berman  
Vera-Ellen Bernard  
Margaret June Berol  
Ricarda Beate Berry  
Wanda Joyce Bettini  
Rebecca Elise Bideaux  
Kevin John Billerman  
Karen Kay Billings  
Robert Einar Bjorhus, Jr.  
Elizabeth Harrison Black  
Steven Franklin Blalock  
James Edwin Blanchard  
Mayling C. Blanco  
Jeffrey David Blass  
Francine Blei  
Michael William Blevins  
Richard Owen Block  
Kathleen Wendy Blouin  
Barbara M. Blount  
Mark Robert Blum  
Raymond Kent Boardman  
John Jeffrey Boerger  
Mark John Bogatin  
David Sprott Boger  
Ralt Wyn Bohn  
Robert Burkhart Bolinger  
Michael I. Bomgardner  
Susan Elizabeth Bonar  
Sheryl Hart Bond  
Mark Evan Bonds  
Henryk Stephen Borecki  
Rebecca Ellen Bormann  
Fred Tillman Bowers III  
Donald H. Bowles  
Darrell Frederic Boyd  
Carol Frances Boyles  
Michael Vincent Bradford  
Stephen Kent Bradley  
Elizabeth Scott Bradshaw  
Ellen Louise Brandenburg  
Mary Margaret Branscomb  
Ruthanne Breedlove  
Laura Jayne Breedon  
Celia Ann Brewer  
Eric Carlton Brinsfield  
Kathryn Price Broderick  
Ellen Epstein Bromley  
Michael David Bromley  
Evelyn Brooks  
Morris Jackson Brooks, Jr.  
Sarah Jane Broom  
Diane Marie Browder  
Joseph Garber Browder  
Ardith Ferguson Brown  
Beverly Anne Brown  
Charles E. Brown  
Katharine Creevey Brown  
Polly Randolph Brown  
Holly Beth Brubach

Sheila Beth Bryson  
Vikki J. Bubas  
Mary Claire Buchheister  
Barbara Joyce Buchholz  
Amy Schwartz Buckey  
Beverly Phyllis Buckley  
Jan Cecile Buffkin  
R. Alan Burcaw  
Milbre Elizabeth Burch  
John Edward Burgess  
Joe Carter Burgin III  
Kara Lisa Burney  
Sidney Johnson Burris  
Philip Stevenson Busby  
J. Kevin Buster  
Gregory Stewart Butler  
Stephen Frederick Butters  
Mary Barbara Campbell  
Suzanne Ross Campbell  
Robert Charles Canali  
Humberto Cancio, Jr.  
Eric Peter Cardinal  
William Evans Cariello  
Grady K. Carlson  
Marcia A. Carney  
Jeffery Crawford Carpenter  
Kyle Matthies Carpenter  
William Geoffrey Carpenter  
Susan Patricia Sparrow Carson  
Dan Thomas Carter  
César Vicente Cauce  
Elizabeth Wanda Cecelski  
James Albert Cederberg  
David Albert Chandler  
Suzanne Hollinger Chapin  
Randall Freeman Chauvin  
Sally J. Cheper  
David Andrew Cherry  
Signe Edith Chickering  
Patricia L. Chilcote  
Linda Darnell Childs  
Jeffrey Merrill Christopher  
Wesley Keith Church  
Russell Gordon Chute  
Reginald Jerome Clark  
Beverly Stonestreet Clayton  
Richard Edward Coachman, Jr.  
James Lowry Smith Cobb  
Richard Marcus Cobourn  
Michael John Codi  
Jeffrey Lee Cohen  
Josephine M. Cohick  
Patricia Anne Cole  
June Ann Colella  
Elaine Kachur Colley  
Carolyn Alta Conley  
Burton Cornell Conner  
Peter F. Coogan  
Terry Douglas Cooper

Marion Patterson Coppedge  
 Curtis Howard Cost  
 Patrick Joseph Coughlin  
 Paula Craige  
 James Rust Crosby  
 Walter Robert Crowley  
 Mark Dowdell Cullen  
 Constance Louise Cummins  
 Charles Watson Cunningham  
 Pamela Anne Cunningham  
 Lynne Shelton Curry  
 Frank Cuthbertson  
 James Francis Dalton, Jr.  
 Richard Andrew Dalton  
 George Williamson Dameron  
 Cristin Ann Daniel  
 Deborah Suzanne Daskam  
 Charles Hunter Daugherty  
 Steven Garth Davidson  
 William D. Davies  
 Dean Allen Davis  
 Linda Gaye Davis  
 Judith Elaine Dayhoff  
 Stuart Lounsbury Dean  
 Juan Rafael de Armendi  
 Martin Crawford DeGraw  
 David Robert DeHaas, Jr.  
 Kathryn Trimpi DeHoff  
 Michael John DelCollo, Jr.  
 Ralph Michael Della Ratta, Jr.  
 Dana L. Dembrow  
 Susan Gail Demming  
 Rachelle Laurice Dennis  
 Lee Stephen Dennison  
 Gregory Dana Devereux  
 Eugene Robert DeVine, Jr.  
 Leslie Anne DeVoe  
 Clarence Harley Dickson III  
 James T. Dietch  
 Mary Elizabeth Dobson  
 Roger Thaddeus Domagalski  
 Janet Marie Doss  
 Ann Wallace Douglas  
 John Stephens Downs  
 Michael Edward Dresser  
 William James Drummond  
 Steven Joyce Dryden  
 Erin Louise Duffie  
 Stephen William Duffy  
 Ray Brown Duggins, Jr.  
 Susan Gayle Duncan  
 Susan Wray Duncan  
 William George Dunn  
 Andreas Duus III  
 Robert Christian Early  
 Christopher Frank East  
 Norman Dwight Eaton  
 Paula Naomi Ecklund  
 David Glen Edwards  
 Sharon E. Edwards  
 Warren Neil Eggleston, Jr.  
 Michael Harold Elliott  
 Holly Ann Elmendorf  
 Marilyn Jean Endriss  
 Samuel E. Enfield III  
 Carolyn Christine Engle

Karen Ann English  
 Harold William Ettinger  
 Douglas Edward Ettus  
 Carolyn Ann Evans  
 David Leonard Evans  
 Daniel Eric Everitt  
 Ruth Watkins Faison  
 Carol Lynn Fall  
 Georgiana Moore Farley  
 Gregory Francis Farrell  
 Kathryn Ann Farrell  
 Sarah Allen Faulkner  
 Clifford Eric Felder  
 Robin Ann Ferracone  
 Nancy Ann Ferree  
 Robert Meddin Fields  
 James Grant Filer  
 Jerrold Michael Filipiski  
 Ann Elizabeth Finnell  
 Deborah Lee Fisher  
 Robert Phillip Fleischer  
 Richard Dudley Floyd IV  
 James Patrick Forbes  
 Charles Stephen Ford  
 Benjamin Cleveland Fordham  
 David Rush Forquer  
 William Ware Forrester  
 John Bradley Fortune  
 Stephen Lawrence Fosberg  
 Harvey Clayton Foushee, Jr.  
 Lawrence Lee Foust  
 Robert Sheldon Fox  
 Richard N. Franklin  
 Stephen Edwards Franzén  
 James Matthew Frazier  
 Mary Louise Fredericksen  
 Kristine Ellen Freeark  
 Elsa Marie Freeman  
 Alan Cochrane French  
 Michael A. Friedberg  
 Karen Ann Frisch  
 Tobias Bodwell Fritz  
 Robert Lewis Frizzelle  
 Bruce Eric Frost  
 Cheryl Lynn Fuller  
 Janis Lynne Fulton  
 Florrie Margaret Funk  
 William Grant Furbush  
 Janice Neff Furlong  
 Andrew Fylypowycz  
 George Elroy Gadson  
 Steven David Gage  
 Anthony Nick Galanos  
 Mary Elizabeth Gallagher  
 Dennis Patrick Gallaher  
 Robert Thomas Gamble  
 John Howard Gardner  
 Steven Charles Garland  
 James Douglas Garraux  
 Michael Edward Gathings  
 Daniel Miller Gautier  
 Martha Love Gayle  
 Margaret Ann George  
 Richard Mark Gergel  
 James Nelson Gerhard  
 Lee Gerin

Susan Jo Geror  
 Teresa Lea Gholston  
 Clarence J. Gideon, Jr.  
 Allison Cooper Gilbert  
 Brent Garland Gilliam  
 Gaylee Williams Gillim  
 Sara Brooke Glenn  
 Joseph Charles Glennon  
 Carolyn Cater Glover  
 Steven Abram Godfrey  
 Thomas James Gooding  
 George Herbert Goodrich, Jr.  
 Suzann Jurgensen Goree  
 Robert Henry Grabner, Jr.  
 Linda Carol Graef  
 Michael Kuhn Gray  
 Peter Allen Graybill  
 Bynum Lura Griffin  
 Carol Anne Gronquist  
 Douglas Marvin Gropp  
 Robert Stuart Gross  
 John Baynard Guerard, Jr.  
 Jeffrey John Guyon  
 William Walter Haefeli  
 Chris Eric Hagberg  
 John Henry Hale  
 M'Liss Marie Halsey  
 Andrea Louise Hammerschmidt  
 Ted Hanenberg  
 Daniel Clyde Hankey  
 Stephan Douglas Hanna  
 Daniel Joseph Hanson, Jr.  
 Stuart Keith Harary  
 Richard Frank Haraway  
 Marcia Delain Hardee  
 Robert Michael Hardgrove  
 Kenneth Waller Hardin  
 Willard Graham Harrelson, Jr.  
 Brenda Gail Harrison  
 George Stephen Hartley  
 M. Alycia Hassett  
 Charles Frederick Hauser  
 Peter Robert Hauspurg  
 Janice Hayhurst  
 Kathryn Ann Healey  
 Frank Shipley Heberer  
 Elizabeth Ann Hedrick  
 Marla Constance Hegyan  
 Holly Lisbeth Hemsworth  
 Clarence Douglas Henard, Jr.  
 Barbara Lynette Henkel  
 James Warren Henry  
 Martha Anne Henry  
 Richard C. Henry  
 Robert P. Hensel  
 Camilla Margaret Herlevich  
 Michael Curtis Herrmann  
 David Floyd Herzig  
 Paul Frederick Herzog  
 Julie Kay Hesler  
 Douglas Craig Heston  
 David Milton Hetherington  
 Sue Baylor Hicks  
 John A. Hill  
 John Kenneth Hill  
 Kai Minoru Hirano



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Richard Xavier Hodde	David Kennickell	Victoria Lynn Mamin
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 Holly Lisbeth Hemsworth  
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 John Stephens Downs  
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 Darrell Frederic Boyd  
 David Campbell Kohler  
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 Patricia Ann Karatsis  
 Elizabeth Lynn Earle  
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 Amy Schwartz Buckley  
 E. Marie Wilson  
 Joan Purkrabek

Michael John Codi  
James Edwin Blanchard

Joseph John Smallhoover  
Leslie Rudolph Miller

Michael David Greene

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Stephen Jay Labensky

#### Biomedical Engineering

Joseph Alan Rappazzo

#### Botany

Timothy Porter Denny

#### Chemistry

Marsha Gale Adams  
John Davis Bolt  
Frank Ripley Brown, Jr.

Gene Everette Keyser  
Marshall Edward McCabe III  
Richard Louis Ruhlen

Leonard Shpack Wojnowich

#### Civil Engineering

Richard Robert Davidson  
Anthony Rudolph Dover

David Bruce Epstein  
B. Edward Kluttz, Jr.

David Reed Markle

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Paul Walter Schach

#### Economics

Merl Wilson Baker  
Morris Jackson Brooks, Jr.  
David Robert Dehaas, Jr.  
Andreas Duus III  
Harold William Ettinger  
Gregory Francis Farrell

Clarence J. Gideon, Jr.  
Linda Carol Graef  
Robert Stuart Gross  
Julie Kay Hesler  
Douglas Craig Heston  
Gary Stephen Jacobs

Ezra David Margolis  
Charles Dean McGrath, Jr.  
Douglas John Pahl  
Diane Lynn Passerini  
Deborah A. Turton

#### Education

Laura Jayne Breedon

#### Electrical Engineering

Glenn Bradley Bilane

Mark Christopher Bussmann

David Park McCallie, Jr.

#### English

Janis Lynn Fulton  
John Kenneth Hill

Charles Marshall King

Nancy Noechel

#### Germanic Languages and Literature

Gergory Vail Keating

#### History

Patricia Anne Cole  
Carolyn Alta Conley  
Peter F. Coogan

George Dameron  
Warren Neil Eggleston, Jr.  
Elizabeth Anne Lunbeck

Lawrence Davidson Pless

#### Mathematics

Jerrold Michael Filipski

#### Mechanical Engineering

Hugh George Chilton III

Stuart Forster Cogan

William Frederick Enright, Jr.

#### Music

Mark Evan Bonds

#### Nursing

Marshall Ann Sutton



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Donald Charles Slowik

**Political Science**  
George Randall Avery  
Kenney Ray Beadles  
James Humphrey Becht  
Beverly Anne Brown

**Psychology**  
Anne Stokes Adams  
Kay E. Anderson  
Patrick Joseph Coughlin  
James T. Dietch  
Harvey C. Foushee, Jr.  
Kristine Ellen Freeark  
Janice Neff Furlong  
Stuart Keith Harary  
Donna Graves Hurlock  
John Wesley Hutchinson

**Public Policy Studies**  
Linda Cheryl Markus

**Romance Languages**  
Christine Denise Swafford

**Sociology**  
Stephen Edward Shore

**Zoology**  
Janice Lynn Bird  
Stuart Irwin Harris  
Cecil James Holliman  
Patricia Ann Karatsis  
Lisa Kauffman

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James William Young

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Stephen Judson Westgate  
Finis Elvyn Williams III

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### Distinguished Graduates

William Grant Furbush

David Frederick Shutler

## SCHOOL OF ENGINEERING

**Summa cum laude**  
Malcolm Tufts Shealy  
David Park McCallie, Jr.  
Hugh George Chilton III

William Craig Sando  
Michael Lewis Halladay  
David Martyn Wheeler

Mark Christopher Bussmann

**Magna cum laude**  
Scott Rollins Crowgey  
Diane Merrill Davidson  
Kenneth Earl Gerlitz  
John R. Lane  
B. Edward Kluttz, Jr.  
Wade Thomas Cooper, Jr.  
Kent Carlyle Hustvedt

David Reed Markle  
Frank Wentzel Gayle  
Anthony Rudolph Dover  
Stephen W. Hamilton  
David Charles Froehlich  
Timothy Paul McClain  
Francis Allan Moody

Joseph Alan Rappazzo  
David Markwordt  
Thomas Edwin Hall  
Tyler Dawson  
Theodore James Reynolds

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Mark Christopher Bussmann  
Hugh George Chilton III  
Scott Rollins Crowgey  
John Winder Bailey Curtis, Jr.

Diane Merrill Davidson  
Charles Stratton Demosthenes  
Anthony Rudolph Dover  
David Charles Froehlich

Michael Lewis Halladay  
Kent Carlyle Hustvedt  
B. Edward Kluttz, Jr.  
David Reed Markle

David Park McCallie, Jr.  
Timothy Paul McClain

Francis Allan Moody  
William Craig Sando

David Martyn Wheeler

## SCHOOL OF NURSING

### Magna cum laude

Lisa Ellen Flint  
Regina Ann Boval  
Louisa Douglass Stiles Levy  
Carrie Ellen Goodwin  
Kathy J. Noble  
Mary Malvina Alderman

Wendy Louise Koenig  
Marcia Lucas Bacon  
Caryl Lynn Zolldan  
Sue Carroll  
Jean Miner Herbert  
Carissa Reynolds Enright

Holly Renee Neil  
Deborah Sue Wilcox  
Elizabeth Shelton Montgomery  
Roberta Eileen Kaplan

### Elections to Beta Epsilon Chapter of Sigma Theta Tau

Mary Malvina Alderman  
Marcia Lucas Bacon  
Virginia Daniels Baker  
Laura Leigh Barbour  
Tina Diane Braseth  
Blanche McDavid Campbell  
Sue Carroll  
JoAnne Lynn Davis  
Lisa Ellen Flint

Carrie Ellen Goodwin  
Jean Miner Herbert  
Rosemary Hickey  
Deborah Jean Hoare  
Teresa Marie Jones  
Karen Kent  
Wendy Louise Koenig  
Louisa Douglass Stiles Levy  
Ethel Brooks Livingston

Sarah Bernhardt Maxwell  
Geri Haney McAlister  
Holly Renee Neil  
Kathy J. Noble  
Katharine Brooke Stebbins  
Marshall Ann Sutton  
Susan Jean Thomas  
Katherine Elizabeth Ward  
Caryl Lynn Zolldan

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Margaret Susan Allison  
John Anton Barnett III  
Rudy Michael Baum  
Thomas Lewis Beardsley  
Nancy Scott Becker  
Arlene Louise Bender  
Richard Owen Block  
Joseph Allen Boone  
Zebulon Lynn Bowman  
Virginia Courtney Broadus  
Frank Ripley Brown, Jr.  
Mark Christopher Bussmann  
J. Kevin Buster  
Philip Joseph Butera  
William Geoffrey Carpenter  
Hugh George Chilton III  
Reginald Jerome Clark  
Michael Lee Cooper  
Scott Rollins Crowgey  
George Williamson Dameron  
Diane Merrill Davidson  
James T. Dietch  
Mary Elizabeth Dobson  
Michael Edward Dresser  
William James Drummond  
Vincent James Egizi, Jr.  
David McNabb English  
Daniel Eric Everitt  
Robin Ann Ferracone  
Jerid Martin Fisher  
Richard N. Franklin

Cheryl Lynn Fuller  
Richard Mark Gergel  
Teresa Lea Gholston  
Kenneth Earl Gerlitz  
Christine Lynn Graham  
Michael Lewis Halladay  
Stuart Irwin Harris  
Sue Baylor Hicks  
Donna Graves Hurlock  
David W. Ichel  
William Hazard Jefferis  
Melissa Ramirez Johnson  
Lisa Kaufmann  
Charles Marshall King  
Martin Moyer Klapheke  
Allison Jean Krahling  
Marsha Jean Kuhn  
Barry William Lee  
James Edward Lee  
Peggy Susan Lindsey  
David Park McCallie, Jr.  
William Lacy McCarty  
Jacqueline McKinney  
Deborah Lea Mantell  
Ralph Alan Marshall  
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Malcolm Tufts Shealy  
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Bryan Leonard Smith  
Kevin Alan Somerville  
Theresa Ann Steeper  
John Allen Stevenson  
John Burnett Strott  
Timothy Mason Sublette  
Marie Christine Swift  
Janice Trawick  
Robert Sidney Truesdale  
Robert Spilman Turner  
Lydia Helen Vollmer  
George Richard Wagoner, Jr.  
Betsy Ellen Walker  
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Thomas Blumeyer Weaver  
Ralph E. Whatley III  
David Martyn Wheeler  
Evelyn Hartwell Wright  
Stephen A. Yoder  
James William Young  
Peter Kevin Zirkle  
Dale Andrew Zolnick

## SPECIAL PRIZES AND AWARDS

*Aaronson Scholarship Award*—Lisa Ellen Flint

*ACC Plaque for Excellence in Scholarship and Athletics*—Robert Phillip Fleischer

*American Society of Civil Engineers Prize*—Michael Alan Freeman, W. Lee Shoemaker

*Alice M. Baldwin Scholarship Award*—Jeanne Elaine Beers, Laura Jayne Breedon, Elizabeth Ann Hedrick, Sara Glen Power, Gwendolyn Rose Simmons

*Julia Dale Prize in Mathematics*—Jacqueline McKinney

*Angier B. Duke Memorial Scholarship Award*—Donna Marie Atwood, Arlene Louise Bender, Holly Beth Brubach, Mark Christopher Bussmann, Reginald Jerome Clark, Lee Stephen Dennison, Vincent James Egizi, Michael Harold Elliott, Nancy Ann Ferree, John D. Marcom Fowler, Glenn Douglas Hinson, John Wesley Hutchinson, Melissa Ramirez Johnson, Marion Elizabeth Kiper, Marsha Michele McGraw, Jacqueline McKinney, Brenda Louise Malloy, Martha Rush Mason, Laura Wilson Morgan, Robert Woodall Myatt, Marilynn Ann Prince, Kathleen Michele Ryan, John Alan Snider, John Allan Stevenson, Ellen Anne Thalmann, Harold Anthony Weaver, Jr., Andrew John Weinheimer, James William Young

*Duke University Department of Chemistry Award*—Frank Ripley Brown, Jr.

*Anne Flexner Memorial Award for Creative Writing*—Second Prize—Donald Charles Slowik, Third Prize—Jeffrey David Talmadge

*Edward C. Horn Memorial Prize for Excellence in Zoology*—Stuart Irwin Harris

*William T. Laprade Prize in History*—Carolyn Alta Conley, George Williamson Dameron, Elizabeth Anne Lunbeck

*Moseley Award*—Marcia Lucas Bacon

*James A. Oliver Memorial Award*—Dwight Allen Thomas, Ellen Louise Knobloch

*Outstanding Service Award*—Phylis Christian Harris

*Henry Schuman Prize*—Mark Evan Bonds, Marty Herman

*William Senhauser Prize*—Robert Woodall Myatt, Jr.

*George Sherrerd III Memorial Award in Electrical Engineering*—Malcolm Tufts Shealy

*Karl E. Zener Award*—John Wesley Hutchinson

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John Winder Bailey Curtis, Jr.

John Michael Logsdon

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Joseph Barr  
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Thomas K. Blackwell  
Kevin B. Bounds  
Thomas P. Branch  
Douglas M. Brandt  
Samuel I. Brandt  
April K. Brazell  
Jane E. Breckenridge  
Cynthia L. Brown  
Suzanne C. Brown  
Thomas P. Brown  
William G. Brown, Jr.  
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Gregory J. Burke  
Cynthia Cameron  
Miriam L. Cameron  
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Anne Feininger  
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Robin A. Foster  
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Michael D. Mangum  
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Cynthia K. Matthews  
Sarah A. Matthews



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 Shelagh P. McClure  
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 Carrin F. Patman  
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 Henry S. Pennypacker  
 David E. Pettigrew  
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 Lonnie S. Poliner  
 Claire M. Poyet  
 William C. Price  
 James E. Privette  
 Stefan Pugh  
 Patricia A. Purnell  
 Jeffrey S. Putter

Dennis B. Ragsdale  
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 Eric M. Reiman  
 Cornelia U. Reimold  
 Thomas Richelo  
 Robert L. Ringler, Jr.  
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 Amelia M. Schrag  
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 Leslie A. Schultz  
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 Wendy P. Seligson  
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 Jeffrey V. Smith

Lenwood P. Smith, Jr.  
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 Robert S. Trefny  
 Mary E. Valenzuela  
 Mark D. Van Kirk  
 Bosch Eilyn F. Vanden  
 Patrick M. Vogel  
 Douglas S. Wainer  
 Roger B. Walcott, Jr.  
 Ann G. Walker  
 Harry C. Walker, Jr.  
 Barrye L. Wall  
 David M. Wall  
 J. Douglas Wall  
 Diane E. Waller  
 Bruno A. Walmsley, III  
 Herbert M. Watzman  
 Gale D. Weaver  
 Paul N. Weech  
 Harry M. Weiss  
 James B. Whitaker  
 Anita Robinette White  
 Charles M. Wiener  
 Richard J. Wilbur  
 Neil G. Williams  
 Gregory P. Winn  
 Barbara L. Wolf  
 Philip C. Wolf  
 Marilyn N. Wood  
 Peter G. Wright  
 Janet R. Yarbrough  
 Gary R. Yates  
 Philip W. Yen  
 Katherine K. Yunker  
 David A. Zill

#### Sophomore Class Honors 1974-75

Laurel S. Akin  
 Jeffrey S. Akman  
 Gertrude E. Alcott  
 Virginia C. Allen  
 Janet C. Allran  
 Christopher Ambroze  
 Gretchen E. Anders  
 Roger F. Anderson, Jr.  
 Craig A. Ansel  
 Suzanne E. Ausnit  
 Pamela J. Barlow  
 Jane D. Barnes  
 Kim R. Bauman  
 Linda E. Becker  
 Mary Bednar

Mark K. Begandy  
 Jeffrey T. Behr  
 Marc A. Bernstein  
 Mark W. Bishopric  
 Elysa J. Blacker  
 Charles C. Blaha  
 Carol B. Blakeney  
 Rebecca L. Boehling  
 Bruce Brasher  
 Scott R. Brazier  
 Scott A. Brister  
 Kenneth E. Brown  
 Robert G. Brown  
 D. Lawrence Burk  
 Frederick Byers

Bradley E. Byrne  
 David L. Callihan  
 Richard J. Calvert  
 Stephen D. Campanella  
 Dorothy K. Campbell  
 Maxwell G. Campbell  
 John S. Cargile, III  
 Virginia I. Cheek  
 Sau Hing Mona Chin  
 Molly L. Clark  
 Thomas B. Clark III  
 John D. Clayton  
 Nancy J. Cobbledick  
 David J. Coffman  
 Pamela Cook

Clayton T. Cookerly  
 Armah J. Cooper  
 Jeffrey P. Cooper  
 Timothy D. Costello  
 Joan E. Coukos  
 Gregory G. Cox  
 Robert B. Craig  
 Richard P. Crane  
 David H. Cresson, Jr.  
 Andrew T. Crist  
 Carol D. Crossman  
 Diane V. Cuffe  
 Jane P. Curtis  
 John J. Danelio  
 Kim Lori Davenport  
 Barbara A. Davidson  
 James W. Davis, Jr.  
 Pamela M. Davis  
 Sara Lynn Dawson  
 Richard I. Dean, II  
 Lauren Debuono  
 Betsy Rene Dehaas  
 Maureen J. Demarest  
 Steven H. Dennis  
 David E. Duke  
 M. Tray Dunaway  
 Martha Dunn  
 Charles S. Eby  
 Mary A. Edgerton  
 Guy M. Edmondson  
 Andrew D. Eichner  
 Howard F. Eisinger  
 Thomas Engels  
 Michael J. Eshleman  
 Craig D. Everhart  
 Melissa K. Falkner  
 Jean F. Farrell  
 David S. Feinman  
 Marc D. Feldman  
 Peter M. Feldman  
 Richard J. Fetchick  
 Richard C. Franck  
 Theodore M. Freeman  
 John B. Frieling  
 Edward J. Fudman  
 Carole L. Gallagher  
 Gregory N. Gallagher  
 John A. Gallalee  
 Kim W. Gallimore  
 Sarah W. Garland  
 Frank R. Garrott, Jr.  
 Gina R. Gilland  
 Mark H. Gilliland  
 Amy I. Ginsburg  
 Robert G. Gittin  
 Ellen L. Glassco  
 Ronnie C. Glickman  
 Lawrence E. Goldenhersh  
 Ilene Ann Goodman  
 Karl Keith Grass  
 James F. Graumlich  
 Lewis Greenberg  
 Phillip J. Grigg  
 Peter Gross  
 Janet L. Guyon  
 Mark Ilaas

Karen M. Halgren  
 Bradley L. Hamlin  
 John S. Hammett  
 Michael D. Hamrick  
 Patricia M. Hannan  
 Susan King Hanway  
 Wesley J. Harris  
 Barbara A. Hawk  
 Peter J. Hayashi  
 Dale A. Hayes  
 Richard R. Heckert  
 Christian D. Hege  
 Robin D. Hemrick  
 Holly E. Henschel  
 Georgeanne Henshaw  
 Gerri L. Hibbard  
 David J. Hilleren  
 Darcy Hitchcock  
 Steven E. Hively  
 Stephen A. Hoffman  
 Hazel M. Holden  
 Janet A. Holmes  
 Elizabeth L. Hoop  
 Patricia S. Horne  
 Juana J. Horstman  
 Steven D. Hovde  
 Warren E. Huber  
 John J. Humphries  
 Christopher Hyson  
 James P. Ierardi  
 Warner R. Itschner  
 Martin P. Jacobs  
 Richard D. Jacobs  
 William A. Jolly  
 Joan M. Jones  
 Mary J. Jordan  
 Bernard B. Kahan  
 Elisa A. Kapell  
 Marilyn R. Kaplan  
 Kerry K. Karukstis  
 Lisa A. Katzenstein  
 Cheryl R. Kay  
 Allan R. Kelley  
 Neal Leonard Keny  
 Gregory M. Keyser  
 Paul C. Kleist  
 Paul Konigsburg  
 David B. Koslin  
 Jeffrey P. Krasnoff  
 John William Kreit  
 Kenneth R. Kress  
 David S. Lackey  
 Charles W. Lallier  
 Joseph T. Lamb, III  
 Douglas Paul Lambert  
 Linda E. Lamm  
 Martha A. Lancaster  
 Amy M. Lapwing  
 Susan C. Larson  
 Shelley S. Layman  
 Mary A. Lee  
 Victor C. Lee  
 Timothy J. Leppert  
 Andrew W. Lester  
 Donald R. Lewellen, Jr.  
 Robert D. Lewis

Robert W. Lindblad  
 Kathryn A. Litterst  
 Laura A. Loftin  
 Kimberly A. Loprete  
 Elaine S. Loring  
 Susan C. Lottich  
 Charles S. MacFarlane  
 Thomas H. Man  
 Carroll G. Martin  
 Beverly D. Mason  
 Pamela A. Mason  
 Aileen T. Masterson  
 Melodie C. Matthews  
 Elizabeth G. Maxwell  
 Olivia A. Mayer  
 Nancy B. McCrea  
 Brent M. McDonald  
 Virginia McHale  
 Mary Z. McKenna  
 Arthur T. Meeder  
 Suzanne E. Meeker  
 Roderick B. Meese  
 Charles R. Menzel  
 Margaret E. Metz  
 Richard I. Metz  
 Laura J. Middleton  
 Arthur E. Miller  
 Mark D. Miller  
 Peter M. Miller  
 Steven K. Miller  
 Tara L. Miller  
 William P. Miller  
 William H. Mitchell, Jr.  
 Richard E. Moore  
 Kristi D. Morgan  
 Mary A. Morgan  
 William E. Morgan  
 Hugh B. Morris  
 Robert R. Morrison, III  
 James J. Mulchahey  
 Robert Warren Murray, Jr.  
 George B. Newton  
 David B. Nicolaides  
 Elizabeth Jean Norcross  
 Christopher C. Odell  
 Linda M. Oldenburg  
 Jeffrey J. Pardo  
 Barry D. Parker  
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 Gary L. Phillips  
 Wayne Lyle Poll  
 Lisa K. Post  
 Patricia A. Poyet  
 Mark J. Prak  
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 William S. Putnam  
 Peter D. Quance  
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 Glenn S. Rampe  
 Linda A. Ramsey  
 Ruth A. Randall  
 Arthur J. Raporte, Jr.  
 Linda J. Rehr  
 Martha L. Reiner

Sarah L. Reusswig  
 Claire A. Rickard  
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 Donald E. Rocap  
 Rebecca Romney  
 Randy A. Rosen  
 Jane S. Rosenfeld  
 Julie V. Ross  
 Mary M. Rowland  
 Paul E. Rowsey, III  
 Richard M. Rubenstein  
 Shaw M. Rutledge  
 Margaret B. Sackett  
 Irving D. Sand  
 Nina E. Savin  
 James A. Scaduto  
 James M. Schaffhausen  
 Karen Beth Schick  
 Jennifer M. Schuler  
 Steve W. Schwartz  
 Thomas R. Sealy, III  
 Barbara E. Sears  
 Thomas J. Seely  
 Teddy D. Segal  
 Hope J. Shand  
 Gretchen C. Shappert  
 David J. Sherman  
 Scott I. Sherman  
 Stuart A. Sherman

Catherine F. Sikorsky  
 Lisa K. Simmons  
 Rose A. Smiley  
 Anne E. Smith  
 Jeffrey J. Sourbeer  
 Paul J. Spadafora  
 Donna L. Sparks  
 Thomas E. Stanley, III  
 Jocelyn T. Stedman  
 Deborah S. Steer  
 Carol A. Stern  
 Steven D. Stern  
 David P. Stewart  
 David S. Stewart  
 Linda C. Stewman  
 Allan E. Stiner, Jr.  
 Erin G. Stone  
 Frances L. Stoneberger  
 Jo A. Stoneburner  
 Douglas E. Streusand  
 William W. Stuck  
 Theodore J. Susac, II  
 Margo L. Thienemann  
 Karen Thomas  
 Peter R. Thomison  
 Ann L. Thompson  
 Anne C. Thornhill  
 Andree M. Tremoulet  
 Ava M. Trent

Robert W. Turken  
 Katherine W. Turlington  
 Corwin P. Umbach  
 Robert D. Vorona  
 E. Hoyt Walston  
 Lexie I. Walton  
 Mary G. Ward  
 William B. Watson  
 Elizabeth M. Weaver  
 Patricia M. Weaver  
 Alan W. Weider  
 Alan C. Weinberg  
 Richard M. Weinberg  
 Richard P. Weinberger  
 Barbara L. Weizer  
 Howard A. Werman  
 Karen A. West  
 Raymond E. White  
 Amy G. Williams  
 William B. Wilmer, Jr.  
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 Stephen L. Wooten  
 Robert E. Wright  
 Robert B. Young  
 Samuel A. Yousem  
 Douglas E. Zarookian  
 Frederick S. Zipp

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 Alice S. Ammerman  
 Paul D. Amos  
 James L. Anthony, Jr.  
 Bowman K. Atkins  
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 Juan F. Battle  
 Webster C. Bazemore, Jr.  
 Robert E. Beacham  
 Mark R. Beissinger  
 Nathan B. Benedict  
 Melanie Boughton  
 Mary H. Berg  
 Carl W. Bieneman  
 David A. Bitterman  
 Michael E. Bostian  
 Joseph A. Boulay, Jr.  
 Kathryn S. Bouvier  
 Carole E. Bowers  
 Joseph E. Bradshaw, Jr.  
 Rhett D. Brandon  
 John D. Brandon  
 Carol P. Brandt  
 Stephen Jeffrey Brandt  
 Barbara A. Brehm  
 Marc I. Breslow  
 Kathryn P. Broderick  
 Morris J. Brooks, Jr.  
 Diane M. Browder  
 Lisa E. Brown  
 William D. Brunstad  
 Elizabeth S. Bryan  
 Priscilla A. Burbank

Nancy J. Burr  
 Lee A. Calhoun  
 Terence D. Campbell  
 Cynthia F. Cannon  
 Keith W. Cantrell  
 Claude R. Carmichael  
 James W. Caudill  
 Patricia J. Cavanaugh  
 Laura E. Ceperly  
 Richard T. Chase  
 Eric J. Chirichella  
 Cuyler P. Christianson  
 James B. Clark  
 Martha A. Clark  
 Jayne Candice Cluett  
 Alvin M. Cohen  
 Marilyn Cohen  
 Stephen D. Cohen  
 Gail Coleman  
 Corinne A. Coletta  
 William R. Cox  
 Christopher W. Colford  
 Bruce D. Collen  
 Becky A. Colvin  
 Christine R. Conner  
 Walter R. Cook  
 Terry Douglas Cooper  
 Cynthia M. Copple  
 Lauren E. Cosgrove  
 Jane T. Costlow  
 Catherine C. Cox  
 Thomas A. Croft  
 David B. Cross  
 Wayne H. Crow

Anne Sewall Crozier  
 Mary C. Cruise  
 Edward G. Dahne  
 Cristin A. Daniel  
 Thomas F. Daniel  
 Karl N. Dannehl  
 Robert S. Danziger  
 William D. Davies  
 Brooke H. Davis  
 Charles K. Davis  
 Lant B. Davis  
 Paul C. Davis  
 Stephen M. Denning  
 Dennis W. Dietrich  
 Martha R. Dilworth  
 William J. Doyle, III  
 Mary G. Dozier  
 Robert E. Dozier  
 Steven M. Drucker  
 Susan Strickland Duda  
 James E. Dugoni  
 Patricia I. Dykers  
 William C. Eacho III  
 Mary F. Earley  
 Deborah Edwards  
 John R. Eidson  
 Cynthia L. Elkins  
 Elizabeth C. Elkins  
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 Herbert H. Engelhard, III  
 Karen A. English  
 Stephen Walker Epsten  
 Mark W. Erickson  
 Alice Anne Espenshade

Georgann Eubanks  
 James E. Everhart  
 David B. Everson, Jr.  
 Lawrence R. Falvello  
 Fred S. Farris  
 Judy L. Fearing  
 Lance S. Ferguson  
 Sarah A. Fetter  
 James N. Feuer  
 Brian H. Fluck  
 Katherine W. Forbes  
 Steven R. Frederich  
 David M. Frey  
 David N. Gallaher  
 Diane Louise Gibby  
 Stephen A. Giesecke  
 John P. Glaser  
 David H. Gleit  
 Martha Glenn  
 Carolyn J. Gober  
 Deborah L. Gofreed  
 John A. Golieb  
 Patricia R. Goodson  
 Thomas B. Gore  
 A. Gerrin Gosnell  
 Richard Louis Graner  
 Jonathan Grant  
 June D. Green  
 Barbara J. Hall  
 Karen L. Hardin  
 Robert T. Harper  
 Mark F. Hassman  
 Steven L. Haughton  
 Kenneth R. Hazen  
 Patrick K. Healy  
 Marla C. Hegyan  
 Michael Curtis Herrmann  
 Thomas A. Hicks  
 Mark H. Hittman  
 Wayne K. Hoffman  
 Norman W. Hoffmann  
 Dale E. Hollar  
 Ann D. Holloman  
 Charles A. Holton  
 Sarah F. Holzweig  
 Philip W. Hoon  
 Mei-Chien Huang  
 Charles R. Hubbard  
 Wade P. Huie, III  
 George S. Hurt, III  
 Frances G. Hutchinson  
 Lisa Isabelle Iezzoni  
 Maryann Jacobi  
 Emmett A. Jacobs  
 Clare A. James  
 Georgeanne P. James  
 Henry W. Jones, III  
 Michael Stuart Jones  
 Madelyn D. Kahana  
 Christina S. Kalavritinos  
 Scott R. Kaneff  
 Nick B. Kanelidis  
 Marc G. Kartman  
 David N. Katzin  
 Harvey R. Kennedy, Jr.  
 Candace R. Kibbel

Thomas R. Kiefhaber  
 Barbara E. Kiehne  
 Mary P. Kimmitt  
 David B. Kinney  
 Marcellus C. Kirschner, Jr.  
 Rosemary M. Klemfuss  
 Frederick W. Knight  
 Laura C. Knott  
 Peter M. Koelsch  
 Warren H. Kofol  
 Richard W. Kopenhefer  
 Jill B. Koury  
 Michael K. Kuhn  
 Kim Kunkle  
 Christiane A. Labazee  
 Emilie C. Lake  
 Christopher M. Lakin  
 Cathy Lynn Lalush  
 Robert A. Lambert, III  
 Jacqueline L. Lancaster  
 Donna E. Landry  
 Robert A. Latham, III  
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 Frank E. Lay, Jr.  
 Michael R. Leas  
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 Michael V. Lee  
 Roman Lok-Man Leung  
 Thomas H. Lewis  
 Kenneth C. Li  
 Isabella P. Long  
 Jeffrey R. Lozier  
 Kathryn J. Lucas  
 Stephen B. Luck  
 David E. Lupo  
 Jacquelyn Maher  
 John J. Mahmarian  
 Lorraine Mangione  
 Scott C. Manning  
 Francis G. Mappin  
 Thomas E. Marfing, Jr.  
 Elizabeth L. Marlow  
 Jeffrey R. Masi  
 Barbara M. Massa  
 Sarah K. Masters  
 William J. Matz  
 William T. Maxwell, Jr.  
 Jane M. McCall  
 Carrie A. McCann  
 Marsha M. McCombs  
 John A. McCrary, III  
 Laura K. McDonald  
 Mary M. McGlone  
 Martha P. McNellis  
 Daniel A. McVane  
 Susan E. Mende  
 Elizabeth A. Mertz  
 Robert B. Meyer  
 Eric D. Middlemas  
 Jonathan E. Miller  
 Nancy J. Miller  
 Samuel G. Miller  
 Ann M. Mirabito  
 Julia C. Mitchell  
 David Arthur Montgomery  
 Elizabeth A. Montgomery

Paul Lawrence Moots  
 John D. Moses  
 Jonathan D. Moss  
 Mark B. Motsinger  
 Deborah S. Mow  
 Walter L. Mullen  
 Elizabeth R. Myers  
 Bruce C. Navarro  
 Madelyn J. Newman  
 Kenneth J. Oneill  
 Michael D. Orwig  
 Michael A. Owens  
 Grace M. Park  
 Susan P. Parrott  
 Linda A. Patton  
 Nena L. Perry  
 Karen L. Peterson  
 Laura E. Peterson  
 Cynthia G. Phillips  
 Joe Bradley Pigott  
 Peter Paul Policastro  
 Capie A. Polk  
 Josephine E. Powe  
 Jane E. Prasse  
 William T. Prey  
 Newton G. Pritchett, Jr.  
 Edward S. Proctor  
 Eric A. Putterman  
 Niels Rathlev  
 Mitchell W. Ratliff  
 John M. Recher  
 John G. Rehder  
 Mary L. Reidy  
 Mark A. Richard  
 Christopher L. Richardson  
 Daryl B. Robertson  
 Mark E. Robinson  
 Virginia D. Roettger  
 Abraham Rogozinski  
 Mark Rosenblit  
 Marianne K. Rosenthal  
 Richard R. Rumer  
 Michele J. Rusin  
 William W. Sager  
 Ellen L. Sakornbut  
 Mary M. Samson  
 Walter B. Saul  
 Frank C. Scafuro  
 David Schaeffer  
 Jesse P. Schaudies, Jr.  
 Barbara S. Schiltges  
 Sylvia Ann Scott  
 Fern Segerlind  
 Patricia Sellers  
 Shawn C. Shea  
 Susan E. Shehee  
 John H. Shields  
 David G. Sidebottom  
 Pamela D. Sides  
 Liana C. Silsby  
 Jack Silverman  
 Mary A. Sims  
 Mark Barrett Sindelar  
 Susan M. Smith  
 Margo C. Soule  
 Susan E. Soies



Margaret E. Spurgin  
 John S. Staton  
 Brett N. Steenbarger  
 Molly Keating Stein  
 Steven R. Steinhilber  
 Carroll U. Stephens  
 Lynne Sturm  
 Paul M. Swenson  
 Robert J. Tapp  
 Catherine E. Taylor  
 Charles E. Thomas, III  
 Catherine E. Thompson  
 James L. Thompson  
 James M. Thompson  
 David P. Tietjen  
 Patricia A. Timby  
 Edmund W. Trice  
 Marguerite H. Trover  
 James I. Turner  
 Anne H. Turpin

Robert W. Van Dalen  
 Joseph E. Wagstaff  
 Benjamin H. Waldman  
 Anne R. Wallace  
 Nancy J. Wallis  
 Arthur W. Walsh  
 Linda L. Walters  
 Scott E. Wang  
 Edward D. Ward  
 Marcy I. Wasman  
 Diedrich C. Waterman  
 Leslie E. Waters  
 Robert L. Webster  
 Sally R. Welch  
 Elizabeth L. Werley  
 Barbara J. Wermert  
 Charles E. Wheeler, Jr.  
 Thomas R. White  
 Joanne Wight  
 Jonathan B. Wight

Steben A. Willer  
 Andrew G. Williams  
 Casandra D. Williams  
 Jacqueline A. Williams  
 Lisa H. Williams  
 Laura E. Wilson  
 Frank S. Wochos  
 Susan Wolfe  
 Michael P. Wolff  
 Jeffrey L. Wood  
 Janette Wooldridge  
 William A. Wroe  
 Emily E. Yarbrough  
 Samuel A. Youngman, III  
 Richard C. Yung  
 Janet C. Zechiel  
 Wendy L. Zeilman  
 David K. Zwiener

## SCHOOL OF ENGINEERING

### Freshman Class Honors 1974-75

Carol Anne Armstrong  
 Arthur S. Astorino, Jr.  
 Jeff Allen Baker  
 Eric Foster Bam  
 Francis H. Beam, III  
 Frederic Blum  
 Todd Lebrun Carpenter  
 Thomas David Christopher  
 Jeffrey Alan Cohen  
 Paul Albert Edinger  
 Charles Mixon Ennis  
 Kristine Elizabeth Ensrud  
 David Scott Enterline  
 Jacqueline Maria Fastenau  
 Joseph Albert Faulkner, Jr.  
 James Baker Ferguson, III  
 Brian Franklin Gaston

Jessie Gettliffe  
 Erik Ralph Gillman  
 Michael Griffin Glover  
 Dale Thomas Guidry  
 Middel Anders Hansen  
 Richard Allen Henrikson  
 Thomas Edwin Hoddinott  
 Henry Kent Holland  
 John Garrison Hovis  
 Philip Iorianni  
 Sharon Lee Johnson  
 Arthur Stephen Jordan  
 Peter Witham Just  
 Joe Michael Kellis  
 Henry Laviers, IV  
 Choo-Beng Lee  
 Marjorie Louise Lewis

Jon Erik Lieberman  
 James Charles Lordeman  
 Donald Keith McNeil  
 Pamela Ruth Moore  
 Matthew Allen Mozur  
 Peter Dennis Nehring  
 Beth Ann Pearson  
 Tom Stevens Rodman  
 Lisa Beth Schichtel  
 Reid Gillard Sheftall  
 Bradford Davison Smith, Jr.  
 Susan Victoria Smith  
 James Phinazee Sutton, III  
 Lawrence Stephen Valenti  
 Earl Corban Vickers  
 Martha Margaret Youngblood

### Sophomore Class Honors 1974-1975

Steven Craig Bartolutti  
 Joel R. Buchanan, Jr.  
 Robert Smith Burrus, Jr.  
 Jonathan Rowell Burton, Jr.  
 Roger Anthony Carolin  
 Alastair Norman Couper  
 Kenneth Jay Doniger  
 Frederick Ernest Ehrsam, Jr.  
 Wesley Kent Fuchs  
 Brian Louis Grundmeier  
 Otha Morton Harris, Jr.  
 Bruce William Hoffman

Elizabeth Anne Hooper  
 Robert Timothy Hyatt  
 Robert Thomas Kraemer, Jr.  
 Richard Fleming McLean  
 Christopher Rowe Mellott  
 William Dana Middleton  
 John Douglas Millan  
 Pamela Dawn Mohr  
 Christopher Ken Northup  
 Randall Frank Olson  
 Charles Edward Wilson Pierce  
 Robert Francis Pierry, Jr.

Richard Montgomery Prevatt, III  
 Marc David Rafal  
 Thomas Frederick Rahifs  
 Margarita Maria Rehbein  
 William Russell Scheirman, II  
 Basil Henry Scott, II  
 Charles Edward Spritzer  
 Steward Frazier Stowers  
 Russell Robert Walker  
 Cliff Al Younger

### Junior Class Honors 1974-1975

Edward Anapol  
 Jeffrey Warren Baker  
 J. Andrew Bohn  
 Lawrence Carlton, III  
 Laurie Catherine Conner  
 William C. Emhiser

Neal Jeffrey Galinko  
 Geoffrey Gunn  
 Phillip Jay Hawk  
 Stuart Jay Heyman  
 Walter Winn Hord  
 Stockton Marion Jones, Jr.

John Cornelius Lyons  
 Ellen Elizabeth Mack  
 Lisa Anne Markel  
 Gordon Edwin Melville  
 Elizabeth W. Miller  
 Gregory Donald Owen

Bayard Lowery Powell  
William Bradley Scantland  
Beth Ellyn Schwanke

Rem Owen Siekmann  
James Madison Snyder, Jr.  
Jeffrey Irwin Spiritos

Edward Trump Stockbridge  
Howard Rhys Taylor, Jr.  
Inho Yoon

## SCHOOL OF NURSING

### Freshman Class Honors 1974-1975

Susan Elizabeth Hanket  
Nancy Susan Heller

Susan Paige Nelson  
Cindy Jo Shapiro

Elizabeth Ann Whanger

### Sophomore Class Honors 1974-1975

Nancy Lee Anderson  
Elizabeth Freeman Baldwin  
Susan Ruth Beck  
Linda Ann Bjornstad  
Linda Joy Bowden  
Mary Susan Choroszy  
Cynthia Laura Close  
Holly M. Cullison  
Kathleen Louise Flanagan  
Lauretta Sue Frederick  
Linda Lou Grasmick  
Patricia E. Gregory

Noreen Haren  
Lois Hildegard Heckman  
Elizabeth Diane Hencken  
Miriam Kay Jernigan  
Constance Maria Lambur  
Karen Ann Leitinger  
Laura Jeanne McVey  
Deborah Susan Peck  
Julie Ann Remter  
Eleanor Gordon Richards  
Patricia Ann Rieser  
Deborah Ann Schwengel

Freda Louise Shillinger  
Leslie Wood Snedaker  
Kim Patrice Spalthoff  
Johanna Elizabeth Surla  
Judith Ann Thorpe  
Ellen Crane Weber  
Peggy Wright Webster  
Kathryn Lee West  
Shelley Diane Williams  
Diane Carroll Wilson

### Junior Class Honors 1974-1975

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Edna Virginia Daniels Baker  
Debra Barrett  
Dorothy Hay Barrus  
Linda Kae Bolle  
Dorothy Love Brodie  
Charlene Rebecca Connolly  
Martha Bebb Coyle  
Donna Ruth Denny  
Patti Anne Dolan  
Debra Douglas Hunike  
Pamela Montgomery Doyle  
Anne Louise Edwards  
Kathy Elizabeth Fellman

Gwen Ellen Gieselman  
Sharon Louise Godwin  
Anne Elizabeth Guerici  
Karen Nowack Hendrickson  
Carol Marie Hixon  
Barbara Ann Jantausch  
Candace Louise Johnson  
Margaret Ross Loizeaux  
Darcy Johnson MacKie  
Julie Elizabeth Matthews  
Nancy Lynne Miller  
Justine Eleanor Muench  
Elizabeth Grace Muir  
Kathleen Ann Nacey

Martha L. Olson  
Deborah Diane Peksa  
Pamela Ann Ryan  
Eleanor Jane Schildwachter  
Ruth Sherry  
Sarah Pinckney Smith  
Eileen Louise Swabb  
Martha Marie Thompson  
Alison Michelle West  
Deborah Ann Woods  
Irene Grace Crabtree  
Priscilla Ann Corey

# Index

- Academic Honors, 37-38  
Academic Regulations, 59-60  
Accounting, Courses, *see* Management Sciences  
Accreditation, 2  
Achievement Tests, 29-30  
Activities, religious, 56; student, 60-63; recreational, 62  
Administration, general, v; undergraduate, v  
Admission, 64-67; requirements, 65; procedures, 66; mid-year, 67  
Advanced Placement Program, 29  
Advanced Courses, 10  
Advising, 32  
Aerospace Studies, *see* Reserve Officers Training Program  
Air Force Reserve Officers Training Corps, 53; scholarship, 76  
Anatomy, *see* Medicine, School of  
Anthropology, Department of, 79  
Application for Admission, 66  
Art, Department of, 85  
Arts and Sciences, *see* Trinity College of Arts and Sciences  
Asian and African Languages, courses in, 89  
Associated Students of Duke University (ASDU), 60-61  
Athletics, 62-63  
Attendance Regulation, 35  
Auditing, 34; fees, 70  
Awards, 38-43  
Bachelor of Arts, Program I, 8; Program II, 13; advanced courses, 10  
Bachelor of Science, Program I, 8; Program II, 13; advanced courses, 10  
Bachelor of Science in Engineering, 16; requirements, 17  
Bachelor of Science in Nursing, 24  
Beaufort, Marine Laboratory, 43  
Bills, 77  
Biochemistry, *see* Medicine, School of  
Biology, courses in, 90  
Biomedical Engineering, departmental requirements, 18; courses of instruction, 249  
Black Affairs, 58  
Black Studies, major in, 91  
Board of Visitors, vii  
Botany, Department of, 93  
Business Administration, *see* Management Sciences  
Calendar, iv  
Canadian Studies, major in, 97  
Career Counseling, 58  
CEEB Achievement Test, 29  
CEEB Advanced Placement Program, 30  
Center for Continuing Education, 49  
Change of Major, 35  
Change of Status, degree, 43; nondegree to degree, 44  
Chapel, Duke University, 56  
Chaplains, denominational, 56  
Chemistry, Department of, 99  
Chinese, courses in, *see* Asian and African Languages, 89  
*Chronicle*, 61  
Civil Engineering, departmental requirements, 19; courses of instruction, 253  
Class Attendance, 35  
Class Honors, 37  
Classical Studies, Department of, 101; in Rome, 46  
College Entrance Examination Board (CEEB), advanced placement program, 29; tests, 30  
Commencement, 37; *see also* Appendix  
Comparative Area Studies, 107  
Comparative Literature, major in, 111  
Computer Science, Department of, 113  
Concurrent Enrollment, 46  
Conduct, regulations governing, 59  
Continuation Requirements, Program I, 12; School of Engineering, 23  
Continuing Education, 49  
Counseling Center, 58  
Course Changes, 32; fees, 71  
Course Credit, 31  
Course Load, 33  
Course Requirements for Graduation, 12  
Courses of Instruction, 78; *see also* departmental listings  
Cultural Affairs, Office of, 61  
*Cum laude*, 37  
Curricular Requirements, 13; Program I, 13; Program II, 14; Bachelor of Science in Nursing, 27; Bachelor of Science in Engineering, 23  
Dance, 62  
Dean's List, 37  
Debts, payment of, 70  
Declaration of Major, 34  
Degrees Offered, 7  
Degree Status, full-time and part-time, 44  
Dental School, preparation for, 15  
Departmental Major, 10; *see also* departmental listings  
Discussion Section, definition of, 9  
Distribution of Courses, 8  
Divinity School, preparation for, 15  
Divisional Requirements *see* Program I, Distribution of Courses  
Double Major, 10  
Drama, 115  
Drop-Add Period, 32  
*Duke Engineer*, 62  
Economics, Department of, 117  
Education, Department of, 123  
Electrical Engineering, departmental requirements, 20; courses of instruction, 259  
Elementary Education Major, 128  
Eligibility for Courses, 33  
Employee Fees, 70  
Employment Opportunities, 58, 77  
Engineering, *see* School of Engineering  
English Composition, proficiency requirement  
English, Department of, 9  
Environmental Studies, 137  
Examinations, final, 35  
Excused Absences, class attendance, 35  
Expenses, estimate of, 69  
Faculty, 3  
Failing Grades, 36

- Fees, registration, 70; transcripts, 71; course changes, 71
- Final Examinations, 35; absence from, 36
- Financial Aid, 72; renewal, 72
- Financial Information, 69-77; student aid, 72; loans, 76; employment opportunities, 77
- First Division, *see* Distribution of Courses
- Food Services, 56
- Foreign Language, proficiency in, 9
- Foreign Language Requirement, *see* individual departmental majors
- Foreign Students, Scholarship, 75
- Forestry and Environmental Studies, courses in, 137; combination program, 14
- French, *see* Romance Languages, Department of
- Full-Time Degree Status, 44
- General Administration, v
- Genetics, The University Program, 138
- Geography, *see* Economics
- Geology, Department of, 139
- Germanic Language and Literature, Department of, 141
- Gift Scholarships, 72
- Government, student, 59
- Grading, 35
- Graduate School, courses, 33; preparation for, 14; Graduate School of Engineering, 15; Business Administration, 15
- Graduation Honors, 37
- Graduation Requirements, Program I, 8-13; Program II, 13-14; School of Engineering, 16; School of Nursing, 24
- Graduation with Distinction, 37
- Greek, *see* Classical Studies, Department of
- Health and Physical Education, Department of, 145
- Health Services, 57
- Hindi-Urdu, *see* Asian and African Languages
- Historical Sketch of the University, 1-2
- History, Department of, 149
- Honors, Dean's list, 37; class honors, 37; graduation honors, 37
- House Courses, 34
- Housing, resident and nonresident, 44
- Humanities, *see* Distribution of Courses
- Identification cards, 47
- Incomplete Work, 37
- Independent Study, Program I, 10
- Individually Designed Plans of Study, *see* Program II
- Inter-Institutional Program, 49
- Intercollegiate Athletic Program, 63
- Interdepartmental Concentration, 10; procedures, 34
- Interdisciplinary Courses, 158
- Intramural Activities, 62
- Introductory Courses, 79
- Italian, *see* Romance Languages
- Japanese, *see* Asian and African Languages
- Judaic Studies, 159
- Judicial System, 59
- Laboratories, 3
- Latin, *see* Classical Studies, Department of
- Law School, preparation for, 15; combination program, 15
- Learning Experiences, Program I, 9
- Leave of Absence, 44
- Libraries, 3
- Linguistics, courses in, 159
- Living Expenses, 71
- Loans, 76
- Magna cum laude*, 37
- Majors, choice of, 34; *see also* departmental listings
- Management Sciences, Department of, 161; preparation for graduate school, 15
- Marine Sciences, the University Program, 165
- Marriage, 56
- Mathematics, Department of, 167
- Mechanical Engineering, departmental requirements, 21; courses of instruction, 265
- Medical School, basic science courses, 172
- Medieval and Renaissance Studies, major in, 173
- Men's Residence Halls, 55
- Microbiology and Immunology, *see* Medical School
- Military Science Courses, 10
- Music, Department of, 177; organizations, 61
- Natural Sciences and Mathematics, *see* Distribution of Courses
- Naval Reserve Officer Training Corps, 50
- Naval Science, courses in, 218
- Newspaper, *see* Publications
- Nondegree Status, 44
- Nonresident Students, 44
- Nurse Corps, Army and Navy student programs, 53
- Nursing, *see* School of Nursing
- Off Campus Living, 56
- Officers of the University, v
- Organizations, Associated Students of Duke University, 60; social and cultural, 61
- Part-Time Degree Status, 44
- Pass/Fail Option, 36
- Passing Grades, 36
- Payment of Bills, 77
- Phi Beta Kappa*, 38
- Philosophy, Department of, 183
- Physical Education, *see* Health and Physical Education
- Physics, Department of, 187
- Physiology and Pharmacology, *see* Medical School
- Placement Services, 58, 77
- Placement Tests, 30
- Political Science, Department of, 189
- Portuguese, courses in, 225
- Preceptorial, definition of, 9
- Prizes and Awards, 38
- Professional Schools, preparation for, 14; combination programs, 14
- Program I, 8; proficiency in English composition, 9; proficiency in foreign language, 9; learning experiences, 9; departmental major, 10; interdepartmental concentration, 10; double major, 10; advanced courses, 10; military science, 10; graduation, 13; residence, 12; continuation, 12
- Program II, admission, 13; general requirement, 14



Psychology, Department of, 201  
 Publications, 61  
 Public Policy Studies, 207  
 Radio Station, WDBS, FM and AM, 62  
 Reading-out of Introductory Courses, 31  
 Readmission of Former Students, 67  
 Reciprocal Agreement with Neighboring Universities, 49  
 Records, release of, 47  
 Recreational Activities, 62  
 Refunds, 71  
 Registration, 32; course changes, 32; late fee, 32  
 Religion, Department of, 211  
 Religious Activities, 56  
 Remission of Tuition, 76  
 Requirements, Program I, curricular, 9; Program II, general, 13; School of Engineering, 16; School of Nursing, 24  
 Reserve Officer Training Program, 50; courses, 217  
 Residence Requirements, Program I, 10; School of Engineering, 22; School of Nursing, 27  
 Resident and Nonresident Status, 44  
 Residential Facilities, 55  
 Romance Languages, Department of, 221  
 Rooms, *see* Housing  
 Russian, placement, 30; *see also* Slavic Languages and Literatures  
 Scholarships, 72; foreign students, 75  
 Scholastic Aptitude Tests, 65  
 School of Engineering, purpose, 4; departmental requirements, 16; interdisciplinary programs, 22; degree requirements, 16; housing, 55; food expenses, 69; prizes and awards, 41; scholarships, 72; courses of instruction, 247  
 School of Nursing, facilities, 4; purpose, 5; program of study, 24; degree requirements, 25; Army and Navy Nurse Corps, 53; housing, 55; food services, 69; social regulations, 59; prizes and awards, 43; student health fee, 70; scholarships, 72; courses of instruction, 243  
 Science Education Major, 129  
 Secondary School Teaching, 129  
 Second Division, *see* Distribution of Courses  
 Second Major, 10  
 Self-Pacing, 33  
 Semester Course, definition of, 7  
 Seminar, definition of, 9  
 Skill Courses, 9  
 Slavic Languages and Literatures, Department of, 229  
 Small-group Learning Experiences, requirement, 9  
 Social and Cultural Organizations, 61  
 Social Regulations, 59  
 Social Sciences, *see* Distribution of Courses  
 Sociology, Department of, 233  
 Spanish, *see* Romance Languages, Department of  
 Statistics, 237  
 Student Activities, Office of, 60  
 Student Aid, 72  
 Student Publications, 61  
 Study Abroad, 45; summer, 43  
*Summa cum laude*, 37  
 Summer Study, Duke, 43; other colleges, 45; abroad, 45  
 Swahili, course in, 90  
 Tau Beta Pi, 41  
 Teaching, 129  
 Theological Schools, preparation for, 14  
 Third Division, *see* Distribution of Courses  
 Transcripts, fees, 71  
 Transfer, credit, 31; between Duke schools and colleges, 44; admission, 67  
 Transportation, 27  
 Trinity College of Arts and Sciences, 4, 7-16  
 Tuition and Fees, 70  
 Tutorial, definition of, 10  
 Undergraduate College and Schools, history, 1; resources, 3; purpose, 4  
 Undergraduate-Professional Combination Programs, 14  
 University Calendar, iv  
 Vanderbilt Study Abroad Program in France and Spain, 46  
 Waiver of English Composition Requirement, 9  
 Warwick Exchange Program, 47  
 Withdrawal, from school, 43; from courses, 33  
 Yiddish, 142  
 Zoology, Department of, 237

# MAP OF DUKE UNIVERSITY

## East Campus

- |   |                         |    |                      |
|---|-------------------------|----|----------------------|
| A | Baldwin Auditorium      | O  | Pegram House         |
| B | Bassett House           | P  | Duke Press           |
| C | Brown House             | Q  | Infirmery            |
| D | Union Building          | R  | Ark                  |
| E | Faculty Apartments      | S  | Crowell Building     |
| F | Art Museum, Geology     | T  | Epworth Inn          |
| G | Aycock House            | U  | Gilbert Addoms House |
| H | East Duke Building      | V  | Southgate Hall       |
| I | West Duke Building      | W  | Campus Center        |
| J | Jarvis House            | X  | Woman's College      |
| K | Carr Building           |    | Gymnasium            |
| L | Giles House             | Y  | Asbury Building      |
| M | Woman's College Library | Z  | Bivins Building      |
| N | Alspaugh House          | AA | Art Building         |
|   |                         | BB | Branson Building     |



## West Campus

- |   |                        |   |                        |   |                    |    |                           |
|---|------------------------|---|------------------------|---|--------------------|----|---------------------------|
| A | Duke Chapel            | H | Hospital Main Entrance | O | Craven Quadrangle  | V  | Card Gymnasium            |
| B | Divinity School        | I | Gerontology, D & T,    | P | Wannamaker Hall    | W  | Indoor Stadium            |
| C | Gray Building          | J | Clinical Research      | Q | Crowell Quadrangle | X  | School of Law             |
| D | Perkins Library        | K | Duke Hospital          | R | Clock Tower Court  | Y  | Gross Chemical Laboratory |
| E | Language Center        | L | Sociology, Psychology  | S | Kilgo Quadrangle   | Z  | Biological Sciences       |
| F | Old Chemistry Building | M | Social Sciences        | T | Union Building     | AA | Plant Environment         |
| G | Davison Building       | N | Allen Building         | U | Flowers Building   |    | Laboratory                |
|   | School of Medicine     |   | Few Quadrangle         |   | Page Auditorium    | BB | Physics Building          |
|   |                        |   |                        |   |                    | CC | Nuclear Laboratory        |
|   |                        |   |                        |   |                    | DD | School of Engineering     |
|   |                        |   |                        |   |                    | EE | Army Research             |
|   |                        |   |                        |   |                    | FF | Medical Center Research   |
|   |                        |   |                        |   |                    |    | Buildings                 |
|   |                        |   |                        |   |                    | GG | Nanaline H. Duke Medical  |
|   |                        |   |                        |   |                    |    | Sciences Building         |
|   |                        |   |                        |   |                    | HH | Warehouse, Shop           |
|   |                        |   |                        |   |                    | II | Bell Building             |
|   |                        |   |                        |   |                    | JJ | Hanes House               |
|   |                        |   |                        |   |                    | KK | Hanes House Annex         |
|   |                        |   |                        |   |                    | LL | Pickens Rehabilitation    |
|   |                        |   |                        |   |                    |    | Center                    |
|   |                        |   |                        |   |                    | MM | Graduate Center           |
|   |                        |   |                        |   |                    | NN | Alumni House              |
|   |                        |   |                        |   |                    | OO | Commonwealth Studies      |
|   |                        |   |                        |   |                    |    | Center                    |
|   |                        |   |                        |   |                    | PP | Personnel Office          |
|   |                        |   |                        |   |                    | QQ | International House       |
|   |                        |   |                        |   |                    | RR | Personnel Office          |
|   |                        |   |                        |   |                    | SS | Education Improvement     |
|   |                        |   |                        |   |                    |    | Program                   |
|   |                        |   |                        |   |                    | TT | A Better Chance Program   |
|   |                        |   |                        |   |                    |    | International Studies     |
|   |                        |   |                        |   |                    |    | Center                    |
|   |                        |   |                        |   |                    | UU | Campus Stores Office      |
|   |                        |   |                        |   |                    | VV | Office of Institutional   |
|   |                        |   |                        |   |                    |    | Advancement               |
|   |                        |   |                        |   |                    | WW | Information Services      |
|   |                        |   |                        |   |                    |    | Visitors Bureau           |
|   |                        |   |                        |   |                    | XX | Admissions Office         |
|   |                        |   |                        |   |                    | YY | Edens Quadrangle          |
|   |                        |   |                        |   |                    | ZZ | Wade Stadium              |















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